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ABSTRACT

A study analyzed the occupational structure and qualifications associated with the field of environmental protection in the metal and chemical industries in the United Kingdom. The analysis included nine case studies based on interviews with firms in the chemicals and metals sectors. Information was gathered within an analytical framework that included functional areas of work, occupational families, core tasks, and modules of competence for selected jobs. Lists of the requirements for each of these areas were compiled. The study concluded that environmental management comprises environmental awareness and technical ability. It also determined that there will be a need for wider awareness of pollution control and for multiskilled employees. Areas of potential training needs identified were in senior management, lower management and supervision, scientific and technological training, and operative training. Three possible areas of skill shortages were identified: environmental management strategies, environmental audits/monitoring, and conformance assessment. Eight actions were recommended, with five enabling factors suggested. (Appendixes, which compose about two-thirds of the report, include the United Kingdom Standard Occupational Classification and the nine case studies.) (KC)

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CEDEFOP Document

Occupational and qualification structures in the field of environmental protection in the metal and chemical industries in the United Kingdom

European Centre for the Development of Vocational Training

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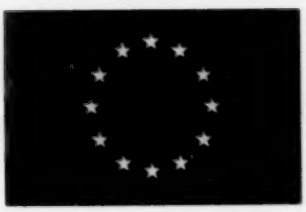

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Occupational and qualification structures in the field of environmental protection in the metal and chemical industries in the United Kingdom

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Preface by CEDEFOP

One of CEDEFOP's main tasks is to cooperate with the Commission of the European Communities in carrying out national and comparative studies of existing and emerging occupational and qualification structures within certain groups of occupations in the most important of the Member States' industrial, trade and service sectors. The findings of these studies are being used to compile an inventory of occupational and qualification structures relevant to the labour market, which is intended both to increase the transparency of the qualifications that will be needed in a future European labour market and to form the basis for the design or updating of initial and continuing training curricula.

These studies also focus on the emergence of or changes in occupational and qualification structures as a result of measures taken in all leading sectors of the economy to protect the environment, especially as all the relevant forecasts indicate that the demand for specific qualifications in the field of environmental protection will increase significantly in the European Community in the next few years.

However, as it would be beyond the scope of the overall project for all the industries examined by CEDEFOP to be made the subject of separate studies aimed at identifying occupational and qualification structures relevant to the environment, we have begun by selecting two sectors in which the protection of the environment is becoming a special challenge: the metal and chemical industries. Our next step will be to extend this research to the public services.

Studies of the metal and chemical industries, which have now been completed, were commissioned in four Member States (Italy, the Netherlands, the Federal Republic of Germany and the United Kingdom). Despite the very short time allowed and financial restrictions imposed by CEDEFOP, which did not permit a representative approach, these studies reveal a wealth of different, yet comparable, findings on changes in occupational

and qualification structures and the emergence of new, environmental occupations.

This has required considerable personal commitment on the part of the authors, and we would like to take this opportunity to thank them for their efforts.

The findings of these studies will be summarized in a report containing comparative tables of the most relevant occupational and qualification structures in the four countries. It will be published in late 1991 (in English, German and French).

Finally, where they have access to appropriate research findings, the Member States which have not participated in this project are urged to draw up reports on occupational and qualification structures in the field of environmental protection in the same industries in their own countries, adopting the same approach as in this and the other studies.

Enrique Retuerto de la Torre
Deputy Director

Gesa Chomé
Project Coordinator

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OCCUPATIONAL AND QUALIFICATION STRUCTURES IN THE FIELD OF ENVIRONMENTAL PROTECTION IN THE METAL AND CHEMICAL INDUSTRIES

1.0 INTRODUCTION

1.1 Background

This report provides an initial analysis of the occupational and qualification structures in the field of environmental protection in the metal and chemical industries. The report has been prepared for CEDEFOP by ECOTEC Research and Consulting Limited. The views and analysis expressed in the report are the sole responsibility of ECOTEC.

1.2 Study Aims

The main aim of the study is to provide an initial analysis of the occupation and qualifications associated with environmental protection. As a starting point for the analysis nine case studies have been undertaken to examine environmental protection practices in the metals and chemical industries.

The analysis has been undertaken within an analytical framework proposed by CEDEFOP. This framework requireds two specific objectives to be met :

- the classification of occupations, associated with environmental protection;
- the definition of occupations, associated with environmental protection.

Given the preliminary nature of the work greater emphasis is given to the latter objective. A more generalised classification analysis must await further empirical research, examining a wider range of functional areas.

1.3 A Definition of Environmental Protection

Environmental protection or, using our preferred nomenclature, environmental management is defined as including :

- pollution control, using "end-of-pipe" techniques;
- waste minimisation, using "cleaner" production techniques;
- recycling of waste products; and the
- management and disposal of pollutants.

Environmental protection and environmental management are used synonymously for the purposes of this report. Specifically excluded are activities chiefly concerned with health and safety, although there are important links between health and safety practices and environmental management, and environmental conservation.

These environmental management activities are undertaken in the polluting sectors (eg. chemicals, metals industry) by the suppliers of goods and services for environmental management and other agencies, comprising mainly regulatory agencies.

1.4 Structure of the Report

The method of approach and analytical framework is described in Section 2.0. The detailed occupational analysis is presented in Section 3.0. Section 4.0 summarises the main conclusions. The actual case studies are presented in Annex B.

2.0 A FRAMEWORK FOR OCCUPATIONAL ANALYSIS

2.1 Analytical Framework

The framework for analysis which has been used in this report is taken from the work undertaken by CEDEFOP, the European Centre for Vocational Training. The framework is consistent with the new Standard Occupational Classification, developed by the Training Agency, in the UK. CEDEFOP are currently preparing a framework for the detailed analysis of all occupations on a standard basis. The use of this framework in this study has two benefits. It ensures that the analysis in this report is broadly comparable with occupational research which might be undertaken in other Member States. Secondly, to the extent that the CEDEFOP framework is adopted by Member States it will ensure that the analysis in this report is broadly comparable with any subsequent research. This latter benefit is considerable given the experimental nature of this study and the anticipated requirement for future occupational research in this area.

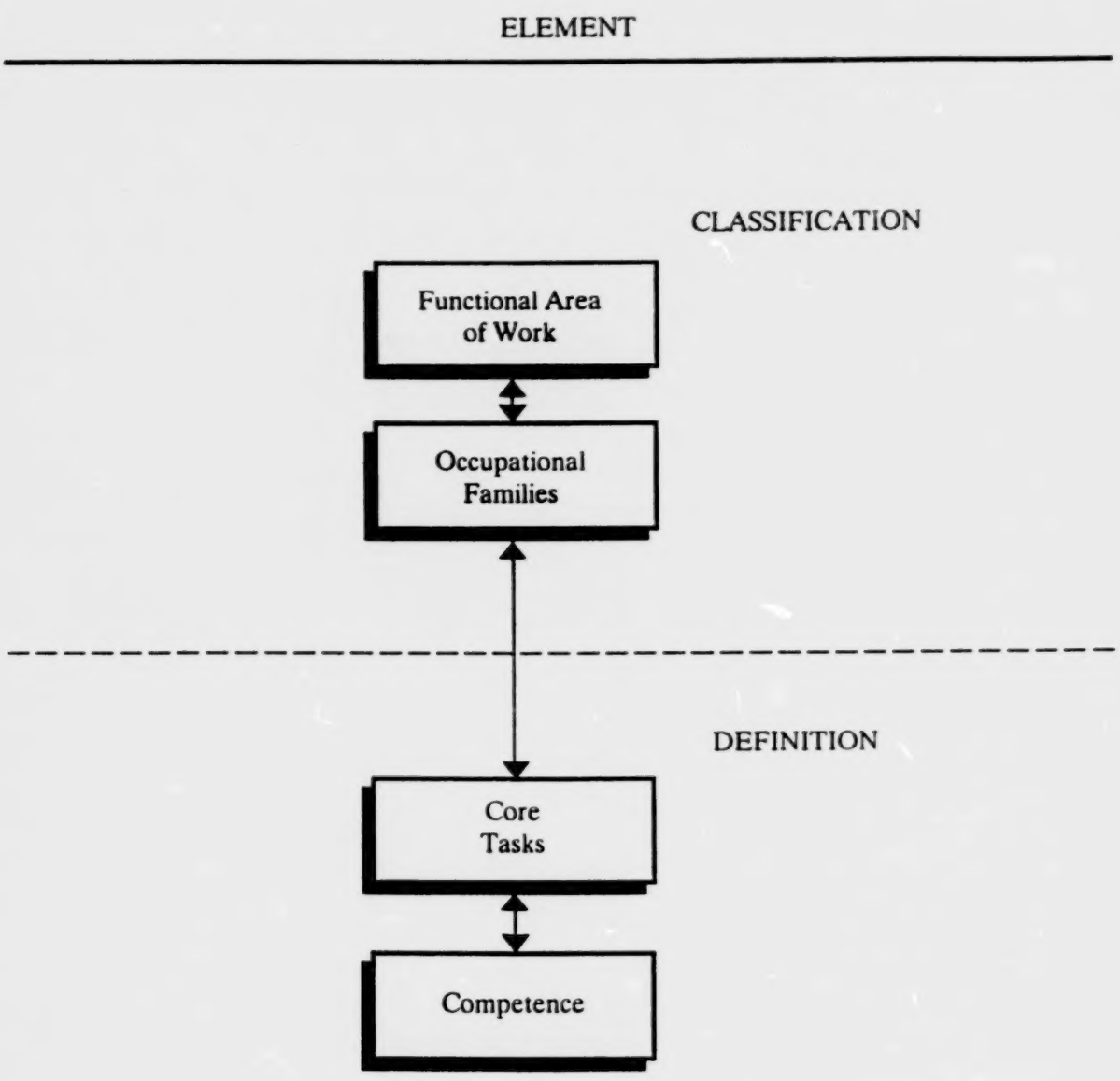
The analytical framework consists of two parts: classification and definition. Each part is then sub-divided into two further elements, providing a total of four elements to the framework. This framework, illustrated in Figure 2.1, allows detailed occupational profiles to be prepared on a consistent basis and defined according to a set of employment tasks. The framework is, therefore, analagous to the new Standard Occupational Classification (SOC), and enables the SOC to be used in an initial classification of occupations. A summary of the SOC is given in Annex A.

The four elements to the occupational analysis are discussed in further detail below.

2.1.1 Functional Areas of Work

Functional areas of work are large aggregates of productive or service functions which do not necessarily, but sometimes, follow the logic of the economic sectors. For example, administration and clerical occupations, or metal working.

FIGURE 2.1 A FRAMEWORK FOR OCCUPATIONAL ANALYSIS



SOURCE : CEDEFOP (1990)

2.1.2 Occupational Families

In each functional area of work there are groups or "families" of occupations. It is these families which relate to the tasks associated with particular jobs, for example, the operation of machines. The new Standard Occupational Classification (SOC), details various occupational families, from very large occupational families (the major groups) through to small families (the unit groups). See Annex A.

2.1.3 Core Tasks

The definition of occupations, in both the CEDEFOP framework and the SOC, is based upon the employment tasks associated with the job. For example, in the occupational family "operation of machine" the following tasks can be identified: study of the design of the workpiece; control of the mechanism; monitoring; etc.

2.1.4 Modules of Competence

For each core task the competences required to exercise the occupation may be defined on the basis of three criteria:

- qualifications or knowledge required;
- competences or skills required; and
- social or attitudes of behaviour required.

By defining these modules of competence the nature of the job can be defined, giving rise to the production of job titles and an appreciation of training received and required.

2.2 Method of Approach

The analysis is informed by the results of a series of case studies. Nine case studies in the UK have been prepared based upon interviews with firms in the polluting sectors of chemicals and metals. These detailed company interviews

focussed upon selected jobs within the plant and have attempted to isolate and define the core tasks and competences required of the job. A summary of the characteristics of the case studies is given in Table 2.1.

TABLE 2.1 SUMMARY OF THE CHARACTERISTICS OF THE CASE STUDIES

Characteristics		Case Study Reference
Industry Sector	: chemicals	C_1 to C_4
	: metals	M_1 to M_5
Plant Size	: Small (<100)	M_4
	: Medium (100-500)	C_1 to C_4, M_1, M_2, M_5
	: Large (>500)	M_3
Jobs Analysed (1)	: Senior manager	M_2, M_5
	: Manager	C_1 to C_4, M_1 to M_3, M_5
	: Scientific (chemist)	C_2, M_2, M_5
	: Supervisor	C_2,C_3,M_2, to M_5
	: Operator	C_2,C_3,M_2,to M_5

Source : ECOTEC Case Studies

Notes : (1) The 9 case studies analysed 27 jobs

These case studies are by necessity, based upon the willingness of individual firms to spend considerable amounts of time with the research team. Thus, it is to be expected that the case studies are unlikely to be representative of all firms in the industries concerned, since firms which have poor, or little, environmental management activity are unlikely to want to be the subject of detailed investigation. Study resources have been spent in attempting to secure the co-operation of reluctant companies with some success. However, the occupational analysis which is based upon the case studies should be interpreted only as an initial and preliminary analysis.

The case studies inform a preliminary definition of the tasks and competences of jobs associated with environmental management. In addition, examination of the Standard Occupational Classification (SOC) combined with the results of the case studies, allows an initial classification of occupation according to the SOC.

3.0 OCCUPATIONAL ANALYSIS

3.1 Introduction

This section presents an analysis of the nature of skills and occupations associated with environmental management. The main focus of the analysis is environmental management in polluting sectors, based upon in-depth discussions with companies in these sectors. The requirement, on industry, for pollution control and prevention means that industry must employ skills to ensure adequate operation of pollution control techniques, be it sophisticated "clean" technology or "end of pipe" equipment. In addition, and arguably more importantly, there is a requirement on industry to be aware of the need to exercise pollution control and for senior company management to prepare environmental audits and strategies for pollution control and waste reduction.

3.2 Classification of Occupations

The classification of occupations, following the framework shown in Figure 2.1 is divided into two parts: functional areas of work and occupational families. The classification of occupations amongst functional areas is based on the UK Labour Force Survey (the most recent data still uses the CODOT system of classification rather than the new Standard Occupational Classification (SOC)). The classification of occupational families is based upon the company case studies and the new SOC. The analysis also makes use of discussions with trade and industry associations.

3.2.1 Functional Areas of Work

Specific industrial sectors, defined as functional areas of work, were identified as having significant environmental management functions. The 1988 Labour Force Survey provides information on the occupational structure of these sectors.

Comparison of the occupational structure for sectors with environmental management functions with the occupational structure of manufacturing industry and all industry indicates that at a broad occupational level environmental management sectors have an occupational structure similar to manufacturing industry as a whole, see Table 3.1.

TABLE 3.1 : BROAD OCCUPATIONAL STRUCTURE BY INDUSTRIAL SECTOR IN THE UK, 1988

Occupation	Sectors with Environmental Management Functions* (%)	Manufacturing Industry (%)	All Sectors (%)
	(Percentage of the Workforce)		
Professional and Managerial	20	18	20
Operative and Technical	47	54	20
Sub-Total Managerial & Technical	*67*	*72*	*40*
Construction and Distribution	10	7	9
Clerical and Sales	16	14	24
Other	7	7	27
Total	100	100	100

SOURCE : Labour Force Survey, 1988

* *Sectors included: electricity, water, chemicals, metals, food processing*

Examination of selected industries, for example water and electricity, with major environmental management functions and of detailed occupations within the managerial and technical occupational categories has also been undertaken. The results, shown in Table 3.2, suggest that environmental management sectors have a slightly higher percentage of the workforce employed in professional (scientific) occupations and fewer employed in technical and operative occupations, compared with manufacturing industry.

Inferences drawn as to the occupational nature of environmental management must be treated with caution since they are based upon a simple classification of occupations at an aggregate level. The main inference which arises is that sectors with environmental management functions employ a relatively high percentage of its workforce in professional, scientific and technology related occupations. This is likely to be due to the nature of the productive process. However, one might intuitively have anticipated environmental management to generate a demand for professional scientists and technologists and, as far as the data allows, this judgement has some support.

TABLE 3.2 : SELECTED OCCUPATIONAL STRUCTURE BY SELECTED INDUSTRIAL SECTOR IN THE UK, 1988

Selected Occupation	Selected Sector					
	Electri -city	Water	Chemicals	Pharmaceu -ticals	Environmental Management Sectors*	Manufact-uring Industry
	(Percentage of the Workforce)					
Professional (Management)	6	6	7	7	5	5
Professional (Scientific)	13	15	12	16	8	6
Managerial	4	6	7	4	7	7
Materials Processing	36	14	31	21	39	43
Repetitive Assembly	2	1	10	13	8	11
Sub-Total (Managerial & Technical)	61	42	67	61	67	72
Other Occupations	39	58	33	39	33	28
TOTAL	100	100	100	100	100	100

SOURCE : Labour Force Survey

**Sector included : electricity, water, chemicals, metals, food processing*

3.2.2 Occupational Families

The classification of occupational families is intended to provide a more detailed typology of the broad range of functions associated with the functional areas of work. This typology, with respect to environmental management functions, has been prepared on the basis of interviews with agencies and firms responsible for environmental management. Specifically, individual jobs within companies and regulatory agencies were examined to identify core tasks. These have been compared with the core tasks as detailed in the Standard Occupational Classification (SOC). On this basis the identified jobs associated with environmental management have been related to minor groups of occupational families within the SOC

The occupational families defined at a minor group level which perform environmental management functions are:

- Production managers in manufacturing, construction and energy industries. (SOC minor group no: 11)
- Specialist managers (12)
- Natural scientists (20)
- Engineers and technologists (21)
- Scientific technicians (30)
- Other associate professional and technical occupations, nes (39)
- Metal machining, fitting and instrument making trades (51)
- Metal forming, welding and related trades (53)
- Plant and machine operatives (80).

Broadly, the occupations associated with environmental management, identified within the case-studies fall into one of the above occupational families.

3.3 Definition of Occupations

3.3.1 Introduction

The case studies identified a range of occupations which involved some responsibility for environmental management. These occupations have been classified in the previous section. In addition the case studies examined 27 jobs in detail to identify specific tasks and competences which were related to environmental management. Actual core environmental management tasks and competences associated with seven of these jobs are presented in Figure 3.1. These selected jobs exemplify the range of tasks and competences associated with environmental management. Figure 3.1 therefore provides a summary of the occupational analysis, within the analytical framework, in so far as this research programme has allowed.

3.3.2 Core Tasks

Core tasks associated with environmental management can be considered separately for managers and operatives. Management tasks broadly relate to production management and to monitoring and analysis. Production management tasks include:

- maintaining awareness of relevant environmental legislation;

Figure 3.1: Occupational Analysis for Environmental Management

INDUSTRIAL SECTOR	JOB TITLE[1]	CORE TASKS (JOB SPECIFIC)[2]	SUGGESTED OCCUPATIONAL GROUP[3]	CORE TASKS (SOC)[4]	TYPICAL ENTRY ROUTES AND ASSOCIATED QUALIFICATIONS[5]	SKILLS AND COMPETENCES[5]
CHEMICAL INDUSTRY	Senior Chemist for the Environment	Developing sampling and analytical techniques, carrying out process research into waste minimisation; investigating new methods of treating waste-streams; supervision of laboratory personnel; attending the company's environment committee.	Minor Group: Natural Scientist SOC 2(a)20/200	Analyse and research physical aspects of chemical structure and change within substances and develop chemical techniques used in the manufacture or modification of natural substances and processed products. Other concerns are the development of experimental procedures and setting up and analysing the results of experiments.	Chemistry degree.	Graduate chemist; 10 years experience as an industrial chemist; understanding of micro-biology; strong skills in analytical chemistry. Understanding of the manufacturing process and a comprehensive knowledge of pollution control technologies.
	Energy Effluent Manager	Responsibility for running the boiler- house; providing site services; responsibility for waste disposal; liaising with the regulatory bodies; providing technical input into waste disposal research; management duties.	Minor Group: Production managers in manufacturing, construction, mining and energy industries SOC 1(a)11/110	Plan, organise, direct and co-ordinate the activities and resources necessary for production in manufacturing industries and the maintenance of engineering items equipment and machinery.	Degree in Chemistry or Chemical Engineering.	Ten years experience in a related field; energy, water or waste management. Extensive knowledge of environmental legislation, particularly waste disposal and local consent levels. Understanding of energy issues (plant and efficiency), man management skills and an understanding of waste disposal techniques.
	Effluent Plant Operator	Operation of the effluent plant; analyses temperatures, flow rates and nutrients; routine testing, sampling and analysis.	Minor Group: Chemicals, paper, plastics and related process operatives SOC 8(a)82/820	Operates the plant to process chemicals and related materials by crushing, milling, mixing and seperating or by chemical heat or other treatment.	Academic qualifications are not normally required. Training is provided primarily on -the-job.	Numeracy and literacy; basic understanding of the operation of the bio-treatment plant; knowledge of the drainage system ie in order to contain spillages; knowledge of consents; process limits ie feed-rate and temperature; interpretation of results from simple analysis.

NOTES:

(1) Job title of post examined in the case studies
(2) Core tasks as defined in the case studies
(3) Occupational Family as suggested on the basis of the job title and defined by the Standard Occupational Classification
(4) Core tasks as defined by the Standard Occupational Classification
(5) Skills and Competences as defined in the Case Studies

USTRIAL SECTOR	JOB TITLE[1]	CORE TASKS (JOB SPECIFIC)[2]	SUGGESTED OCCUPATIONAL GROUP[3]	CORE TASKS (SOC)[4]	TYPICAL ENTRY ROUTES AND ASSOCIATED QUALIFICATIONS[5]	SKILLS AND COMPETENCES[5]
TALS INDUSTRY	Technical Director	Overall responsibility for all technical aspects on-site. Responsibility for process development, responding to legislative changes and providing documentation on emission levels; checking daily monitoring and liaising with group managers regarding environmental targets.	Minor Group: Production managers in manufacturing, construction, mining and energy industries SOC 1(a)11/110	Plan, organise, direct and co-ordinate the activities and resources necessary for production in manufacturing industries and the maintenance of engineering items equipment and machinery.	Degree in metallurgy, chemical engineering or physics.	Ten years experience and a detailed understanding of the operation of the plant; knowledge of environmental legislation; awareness of technical and financial constraints of production; knowledge of pollution control techniques;strong inter-personal, man-management,interpretatior and report writing skills.
	Environmental Services Engineer	Responsibility for identifying the need for new kit and writing the necessary tender documents. Undertaking the conceptual design work to improve the environmental performance of the plant and to ensure compliance with legislation; liaising with regulatory bodies and the public; providing technical advice to plant managers.	Minor Group: Associate professional and technical occupations nec SOC 3(a)39/399	Establishes principles and techniques to improve the quality, durability and performance of materials. Designs new systems and equipment with regard to cost market requirements and feasibility of manufacture. Devises and implements control systems to monitor operational performance and efficiency of the system and materials.	Degree in Chemical Engineering (a candidate with an appropriate level of expertise would be considered without a degree).	Competent engineer with a comprehensive knowledge of th manufacturing process. Good understanding of: environmenta issues, legislation and engineering; knowledge of pollution control, waste management and effluent control technology.
	Tips Controller	Supervision of operative staff; hiring and deployment of machinery; recording the amounts and types of waste; planning waste disposal at the site and responsibility for off-site waste disposal; liaising with external bodies involved with waste disposal.	Minor Group: Other operations nec SOC 9(b)99/999	Miscellaneous tasks not elsewhere classified.	No formal qualifications required. Post holder is expected to have extensive experience in the industry.	In-depth knowledge of waste; broad understanding of the manufacturing process; some, civil engineering background (to assist in the design of the tips) experience of working with mobile tools; high level of inter-personal skills.
	Operative	Monitoring the chemical content of the waste stream (pH,nitrates, temperature); carries out maintenance and operation of the equipment; operation of recovery and separation equipment; supervises the incineration of ammonia.	Minor Group: Metal making and treating process operatives SOC 8(a)83/839	Sets up, assists with and operates piercing, rolling and extruding equipment; assists with the operation of galvanising equipment; operates continuous plant to remove dirt, scale and other surface impurities and performs other metal processing, forming and treating tasks.	City and Guilds certificate in Coal Carbonisation and by-product recovery	Comprehensive knowledge of the plant operation; knowledge of hazardous chemicals and of safe working procedure; knowledge of the chemical processes involved in the plant; knowledge of the parameters within which the plant must operate.
TES:	As before					
URCE:	ECOTEC Case Studies, Standard Occupational Classification					

- developing process changes for compliance with environmental standards;
- setting, and ensuring conformance of the plant with, environmental standards.

Monitoring and analysis tasks include:

- sampling and analysis of waste streams;
- liaison with regulatory agencies;
- preparation of applications for consents and licences.

Implicit in these tasks is an awareness, on the part of the management, that the plant has an impact on the environment. These tasks are typically additional to the core tasks associated with the mainstream production management and scientific analysis associated with the production process. Only in the largest firms are there senior managers and scientists who have a full-time responsibility for environmental management. However, the monitoring and analytical tasks are considered to be growing in importance and scale, as a result of both the increase in environmental standards and control of new substances and the increasing requirement for environmental audits.

Typically these environmental management core tasks would represent in the order of 25% of the time of the job, although in large plants a full time post may be created. In some instances the development of these environmental management tasks is related to existing responsibilities for health and safety or quality control/quality management.

The tasks of operatives do not require any general environmental awareness although frequently the tasks involve operating within a set of parameters in order to avoid exceeding consent limits or violating environmental regulations. The tasks generally relate to the operation of plant and equipment and increasingly sampling and monitoring of waste streams. More senior operatives (supervisors) may be involved in the collation of environmental data and be responsible for on-the-job training. A wide variation exists in terms of the proportion time of a job associated with environmental management, depending on company policy and on the particular type of plant.

3.3.3 Competences

Competences associated with environmental management can again be considered separately for managers and operatives. Managers will require:

- at least a degree level education in science/engineering;
- management competences (personnel/financial/communications);
- at least five years industry experience.

Thus the main competences relate to the scientific, engineering background and managerial and industrial experience. These competences are either gained before entry into the job or through on-the-job training. Environmental management competences are supported through some off-the-job education and training, using a variety of means: exhibitions, conferences, seminars and short courses. Post entry training of middle management is quite rigorous although senior management training is reported to be fairly minimal.

The competences required by operatives are basic production/process engineering skills. These occupations are associated with little or no pre-entry qualifications although City & Guilds is often encouraged post-entry. Laboratory based staff have some basic scientific training, perhaps to 'A' level. However, subsequent to the implementation of Total Quality Management the level of competences required of operatives is expected to rise and it it expected that this requirement for higher standards will be met by increased post-entry training.

The main form of post entry training is to understudy a more experienced operative or less formal on the job training. This training would be expected to be more formalised in larger firms compared to smaller firms.

3.4 Occupational Issues

The detailed analysis undertaken in the case studies, together with the remainder of the research programme, allow a number of issues, relating to the occupational structure and particularly to the development of environmental management occupations, to be identified which inform the conclusions.

3.4.1 Skill Requirements

The occupational analysis indicates that environmental management skills relate to a wide range of occupational families. Thus there are environmental management skills to be acquired and applied at the senior management level, middle management level, supervisory level and operative level.

The discussions with industry associations also reveal that there are issues of awareness as well as technical competence. Environmental awareness includes an appreciation, by the different occupational families, of the impact of the company's production activities on the wider environment.

In the light of the case studies there are three main areas where skills are required. Firstly, there remains a major deficiency in the level of awareness in industry of the requirement for environmental management This lack of awareness relates to an ignorance of: environmental legislation and commercial pressures for enhanced environmental management; how the operation of the plant impacts upon the environment; and the most effective strategies for implementing environmental management initiatives. This lack of awareness is more prevalent amongst smaller firms.

Secondly, an increasing proportion of management time is being spent on the preparation of applications for consents, discharge permits, operating licenses, etc. This process can be legally and technically complex. The rapid changes in legislation mean that companies are pressed to keep abreast, and to understand the implications, of new legislation. The increasing requirement to monitor and measure the environmental impact of the plant, requiring new analytical techniques means that scientific and engineering skills and knowledge need to be continually kept up to date.

Thirdly, preparing specific pollution control and waste minimisation and recycling initiatives in response to the generation of waste streams and pollution can be a technically complex process. The lack of exchange of information between plants, as to the technical environmental management responses, increases the requirement on

individual companies to find their own solutions. External advice and support, however, needs to be specifically tailored to the operating circumstances of a given company. This in turn means that training courses aimed at improving technical responses need to be highly specific.

As part of the discussion of core tasks, above, it was noted that these tasks are typically additional to main-stream tasks. Thus, apart from the very largest firms, industry does not employ full-time "environmental specialists". This has implications for the response to the skill requirements noted above. Typically the plant manager/technical director, together with the company chemist/scientist will require the skills noted above. In addition, many of the future skill requirements which might be expected in the light of possible changes in legislation and technologies, will also need to be satisfied by staff at technical director/senior chemist level.

3.4.2 Sectoral Considerations

The existence of particular skills requirements prompts a consideration of whether these requirements are centred upon particular industries. The development of integrated pollution control (IPC), in the UK suggests that there would be a general requirement across all industry and throughout the full production process for environmental management skills. However, the development of future environmental policy, with specific production processes effected by new legislation, will lead to a sectoral focus in requirements. A good example, is the increasing identification of training requirements in the waste management industry, following new legislation covering waste disposal.

A sub-set of sectoral considerations relate to the size and ownership of the company. Smaller companies face particular difficulties for two reasons: firstly, they have limited resources to ensure sufficient up-to-date information on environmental and technical issues is maintained; and secondly, they are unlikely to be able to employ specialists with responsibility for environmental management, leaving environmental management functions to be added to mainstream company functions.

Foreign companies may have differing requirements, to the extent that UK subsidiaries are expected to comply with environmental management practices of the parent company, or with the environmental standards of the host country, if these standards are stricter than UK standards. A good example is the practice by US subsidiaries of operating to US environmental standards in the UK, even though these are more demanding of the company than UK standards.

Plants which operate as part of a group of companies may have access to group training resources and thus the training for environmental management may be different compared with a plant operating independently.

3.4.3 Training the Trainers

A major source of information and advice on environmental management issues is derived from contact with the regulatory agencies. However, there is increasing concern, given the introduction of IPC, that the regulatory agencies will be required to adopt an increasingly arms-length relationship with industry. More broadly, the provision of environmental education and training is a relatively under-developed area and there has been some concern expressed in this study that there are not sufficient training providers who have the appropriate skills. This concern reflects, in part, the highly specialised nature of the training requirements, with industry requiring, process specific environmental management training. The reduction in the informal information exchange which currently takes place with regulatory agencies will place greater emphasis on the requirement to develop suitable training resources.

3.4.4 Requirements of Specialist vs Generalist

The discussion, above, highlights the requirement for both general skills, including awareness, and specialist skills. To the extent that new education and training provision will be developed, the distinction between generalists and specialists requires some clarification. This issue has been discussed with firms in this study.

Training for environmental management is required at two broad levels; management training and operative training. Management training will have a broader base, being concerned with awareness, philosophy, management attitudes etc, compared with operative training. Operative training will focus on specific technical tasks.

Higher education provision for environmental management is required for industrial managers. However, industry views technically competent graduates (eg, in chemistry or engineering) with an understanding of environmental aspects, as being preferable to "environmental scientists" who have a broad range of environmentally related skills (eg, knowledge of policy/legislation, technologies, environmental impact assessment etc). This implies that in developing education policy in this area, the emphasis should be placed on post-graduate education.

City & Guilds education and training is often undertaken by operatives with environmental management tasks, particularly in process engineering. The move towards a broader based City & Guilds education, away from specific craft related training, is in keeping with the requirement to add additional skills associated with environmental management to mainstream process engineering skills.

3.4.5 Role of the Supplier

The specific training requirements, particularly of operatives, are often met by the supplier of environmental management goods and services. This is the case where the new skills relate to new plant or production processes. Suppliers provide this training as part of the sales package. This service is important because it means that the move towards cleaner technologies is less likely to be constrained by the absence of the necessary technical skills. It also means that the reduced distinction between production and environmental management need not inhibit the acquisition of the necessary skills.

3.4.6 Health and Safety Practises

There is frequently a close relationship between existing health and safety practises and compliance with COSHH regulations and environmental management practises. Good examples relate to the handling of hazardous

materials, eg, chemicals and some waste metals. This relationship means that certain tasks which could be undertaken to comply with environmental legislation are already being undertaken and training supplied according, in order to comply with health and safety practises.

A number of consultees also made the point that the current development of attitudes towards environmental management and the greater attention being given to defining and meeting environmental management tasks mirrors the process which industry has previously been through with respect to health and safety practises. This in turn may be expected to lead, eventually, to the position where attention to environmental management, by all members of a company workforce, will become implicit and automatic.

3.4.7 Total Quality Management

The increasing attention being focussed on total quality management (TQM) by industry leads companies to examine the extent to which they produce wastes and the benefits from waste minimisation initiatives. As a consequence environmental management functions are being identified and new competences are being satisfied. TQM is, therefore, aiding the development of environmental management in industry.

4.0 CONCLUSIONS

4.1 Introduction

This final section summarises the main conclusions with respect to the principal issues which this research programme addresses. In particular, the conclusions aim to provide a framework of considerations upon which the CEDEFOP might develop subsequent research and training initiatives.

The analysis indicates that environmental management comprises, broadly, environmental awareness and technical ability.

The requirement for skills should distinguish between the requirement to train existing staff in new competences and the requirement to recruit staff with additional skills. This research programme has highlighted the importance of addressing the former requirement.

A distinction should also be drawn between general labour market deficiencies which inhibit environmental management and specific skill deficiencies.

4.2 The Specific Impact of IPC

A new system of regulating pollution control, known as IPC, is being introduced in the UK as a result of the Environmental Protection Bill currently before Parliament. The new system will establish a more integrated approach to pollution control and waste management practices within industry, and will have significant implications for future training provision. These are that:

1) There will be a general need for wider awareness of pollution control and waste management techniques in order to ensure compliance with requirements to employ Best Available Technologies;

2) There will be a wider need for multi-skilling as newer, dissimilar environmental protection technologies are employed to meet the objective of integrated pollution control across all media.

3) As pollution control becomes integrated into general production, there will be a widespread need for process engineers to be trained in waste minimisation techniques and to have a greater awareness of so-called "clean technologies";

4) There is a general need to improve professional standards across the waste management industry. Action to achieve this is already being taken.

The general impact of environmental management on industry skill levels relates mainly to the polluting sector and to the environmental agencies. The introduction of IPC, together with the development of new pollution control strategies (taking account of new technologies, changes in costs and benefits etc) is likely to increase the sophistication of environmental management practices, with a consequent demand for more highly skilled personnel. This demand is likely to be met either by increasing the proportion of series management time allocated to environmental management or through the use of external consultants.

4.3 Potential Skill Shortages and Training Needs

The research has highlighted, broadly, the skill requirement associated with environmental management. The requirements are, in summary:

- senior management training;
- lower management and supervisory training;
- scientific and technological training;
- operative training.

The response to these needs, given the preference of industry to train existing staff in new competences and to recruit staff with industrial experience, is likely to depend more upon the provision of training than the provision of education.

In the light of the occupational analysis there are three possible areas of skill shortages which can be identified :

- environmental management strategies;
- environmental audits/monitoring;

- conformance assessment.

Each of these is briefly considered.

4.3.1 Environmental Strategies

The ability of senior management in polluting sectors to prepare environmental management strategies is constrained by a lack of awareness of legislation and environmental management techniques and a lack of conviction that improved environmental management will improve company performance. Thus, provision of information on, and a demonstration of, the importance of environmental management is required.

4.3.2 Environmental Audits/Monitoring

New legislation has increased environmental standards, reducing the concentrations of pollutants which are permitted. New legislation also covers the control of new substances. Increased monitoring and analysis is, therefore, required, with a consequent need to develop new measurement and analytical techniques. In addition, firms are beginning to examine in more detail the impact of the plant on the environment through more extensive analysis of waste streams. These tasks raise a requirement for scientific, engineering and laboratory skills. Moreover, these skills are required not only by firms in the polluting sectors but also in the regulatory agencies and the environmental management industry.

4.3.3 Conformance Assessment

The conformance to environmental standards requires skills both for the negotiation and preparation of consents, licences etc., and to prepare technically and economically optimal solutions, choosing between different environmental management techniques. Thus, a legal and technical awareness is required together with the management, scientific and engineering skills and knowledge to evaluate and implement environmental management solutions. This requires a range of skills, in both polluting sectors and regulatory agencies, especially for senior and middle management, allied to a flow of specific information and advice.

4.4 Actions to be Taken

A range of actions in response to the requirements of industry for environmental management training can be considered. These actions could include:

- A general programme to enhance the environmental awareness of employees.
- Greater provision of information and independent advice on the efficiency and effectiveness of available pollution control techniques.
- A greater use of environmental databases and information systems on aspects such as environmental regulations and pollution control techniques.
- A database, to provide information on short courses and environmental expertise available at various centres;
- Promotion of 'in-house' and 'on-the-job' training by the provision of technical back up material and facilities and flexible "distance learning" information packages that can be used for study by the people concerned at their place of work or home.
- Provision of short courses to keep staff up-to-date with technological and legislative developments and newly emerging environmental problems and to fill certain gaps concerning specific technical and legal aspects of key environmental issues, especially regulations and the implementation of clean technologies.
- Greater integration of environmental subjects into vocational training programmes and university degree courses in the traditional disciplines.
- Specialist/advance training in subjects such as: toxicology; noise and air pollution control; risk analysis; and environmental impact assessment.

The implementation of these actions and their subsequent effectiveness will depend upon a number of factors, including:

- increased legislation;
- senior management conviction;
- availability of financial support, particularly for SME's;
- the pooling of resources between groups of firms;
- increased flexibility of training.

These factors in turn imply that, firstly, the development of actions must, as a primary requirement, be addressed to the need to remove mis-conceptions, of industrialists, of the value of improved environmental management; and, secondly, the actions need to take into account, differences between industrial sectors and between companies of differing size and ownership.

ANNEX A

UK STANDARD OCCUPATIONAL CLASSIFICATION

TABLE 1.1

BASIC STRUCTURE OF THE STANDARD OCCUPATIONAL CLASSIFICATION

MAJOR GROUP	General nature of qualifications, training and experience for occupations in the major group	SUB-MAJOR GROUP
1. Managers and Administrators	A significant amount of knowledge and experience of the production processes, administrative procedures or service requirements associated with the efficient functioning of organisations and businesses.	a Corporate Managers and Administrators b Managers/Proprietors in Agriculture and Services
2. Professional Occupations	A degree or equivalent qualification, with some occupations requiring post graduate qualifications and/or a formal period of experience-related training.	a Science and Engineering Professions b Health Professions c Education Professions d Other Professions
3. Associate Professional and Technical Occupations	An associated high-level vocational qualification often involving a substantial period of full-time training or further study. Some additional task-related training is usually provided through a formal period of induction.	a Science and Engineering Professions b Health Associate Professions c Other Associate Professions
4. Clerical and Secretarial Occupations	A good standard of general education. Certain occupations will require further additional vocational training to a well defined standard (eg. typing or shorthand).	a Clerical Occupations b Secretarial Occupations
5. Craft and Related Occupations	A substantial period of training, often provided by means of a work-based training programme.	a Skilled Construction Trades b Skilled Engineering Trades c Other Skilled Trades
6. Personal and Protective Services Occupations	A good standard of general education. Certain occupations will require further additional vocational training, often provided by means of a work-based training programme.	a Protective Service Occupations b Personal Service Occupations
7. Sales Occupations	A general education and a programme of work-based training related to sales procedures. Some occupations require technical knowledge but are included in this major group because the primary task involves selling.	a Buyers, Brokers and Sales Representatives b Other Sales Occupations
8. Plant and Machine Operatives	The knowledge and expertise necessary to operate vehicles and other mobile and stationery machinery; to operate and monitor industrial plant and equipment; to assemble products from component parts according to strict rules and procedures and subject assembled parts to routine tests. Most occupations in this major group will specify a minimum standard of competence that must be attained for satisfactory performance of the associated tasks and will usually have an associated period of formal experience-related training.	a Industrial Plant Stationary Machine Operators and Assemblers b Drivers and Mobile Machine Operators
9. Other Occupations	The knowledge and expertise necessary to perform mostly simple and routine tasks often involving the use of hand-held tools and, in some cases, requiring a degree of physical effort. Most tasks in these occupations have limited scope for personal initiative and judgement, and may not require formal educational qualifications, but will usually have an associated short period of formal experience-related training. All non-managerial farming occupations are included in this major group, primarily because of the difficulty of distinguishing between those occupations which require only a limited knowledge of agricultural techniques from those which require specific training and experience in these areas.	a Other Occupations in Agriculture, Forestry and Fishing b Other Elementary Occupations

ANNEX B

CASE STUDIES

Case Study C1 presents a chemical company which is a division of a large multinational corporation. The company employs 270 people and has been operating for almost 100 years.

The company produces a range of chemical products including agricultural chemicals (herbicides and insecticides), synthetic latex and polystyrene foams. Manufacturing generates large quantities of waste, the largest component of which is liquid waste (1000 cubic metres per day) which is treated at an on-site facility. Solid wastes are exported off -site and disposed of to landfill and waste-water is discharged to a river.

The company is subject to NRA control and must comply with consents for discharge to the river. The company is also required, under the Control of Industrial Major Accidents Hazards Regulations 1984 (CIMAH) to prepare and submit a report on on-site emergency plans and the likely impacts on man and the environment of a serious accident.

The company complies with the Corporation waste minimisation scheme, the objective of which is to reduce the amount of waste generated. This is achieved by both changing the processes involved in manufacturing and by incorporating recycling and re-use into the manufacturing process. Many corporate projects under this scheme have had payback periods of less than one year.

The company must comply with the corporate environmental policy. Environmental issues are given a high priority by the company .

Responsibility for training lies with each plant manager. Training is primarily carried out formally in-house or informally on-the job. Short courses are used as appropriate. Environmental training is provided to all staff in that all are aware of the objective of the waste minimisation scheme. More specific environmental training is provided as required by an individual's job.

The company employs a Manager for environmental affairs who allocates 100% of his time to environmental management tasks. A further 15 members of staff allocate approximately 25 % of their time to environmental management tasks.

The case study presents an occupational analysis of three jobs: Environmental Manager; Plant manager; and Plant Process Manager.

Occupational Analysis

	Environmental Manager	*Plant Manger*	*Plant Process Engineer*
Tasks	policy and strategy development; advising plant managers; knowledge of legislation; appreciation of corporate requirements; liaising with regulatory authorities; liaising with corporate environmental managers; chairing company waste management committee.	developing company environmental policy; ensuring that discharge consents are met; awareness of applicable legislation; awareness of corporate requirements; providing training; liaising with waste treatment plant staff; supervising staff.	responsibility for waste management; implementation of waste minimisation projects; supervising operatives/fitters; producing documentation detailing waste arisings; audits and disposals; responsible for accident/spillage planning; implementing training programmes; member of the waste management committee.
Skills and Competences	good scientific grounding; a broad understanding of environmental issues; ability to produce reports; understanding of occupational health issues;supervisory skills; negotiating skills.	experience of other corporation sites perhaps outside the UK; financial management skills; technical skills ie a good understanding of the manufacturing process; man -management skills; awareness of environmental issues..	good understanding of manufacturing processes; good understanding of waste management /pollution control, waste treatment technologies; a good knowledge of legislation.
Education and Training	degree in a traditional science discipline ; at least six years industrial experience. The post-holder is not required to be a specialist in environmental science. However post-entry environmental training will be provided both in-house and using short courses.	degree in engineering; experience of working at other sites ouside the UK. No formal pre-entry training in the environment is required. However, post-entry training will be provided mainly in-house by the Environmental Manager or using corporate expertise.	degree in chemical or process engineering. Formal training in environmental science is not required ; post-entry environmental training will be provided relating to waste management technologies and developments in legislation.

CASE STUDY C1

1.0 THE COMPANY

Company C1 is a division of a large multi-national chemical corporation. The company employs 270 people. The site was established over 30 years ago although the corporation is almost 100 years old.

2.0 INDUSTRIAL PRODUCTS AND PROCESSES

2.1 Products

The main products are agricultural chemicals (herbicides and insecticides), synthetic latex and polystyrene foams.

2.2 Processes

Bulk chemicals are brought in from other corporation sites or outside distributors. These include inorganic acids, caustic soda, styrene, butadiene, ammonia, and a wide range of organic (particularly organo-phosphorous) chemicals. A diversity of batch and continuous production processes are used.

3.0 WASTE AND POLLUTION

3.1 Solid Waste

The main solid wastes are filter-cake, centrifuge separated residues, and residues from the liquid waste treatment plant (see below). Those wastes which cannot be reused/recycled are sent off-site for merchant treatment and/or disposal.

3.2 Liquid Wastes

Approximately 1000 cubic metres of liquid waste (aqueous effluents and organic solvents) are generated per day. The majority is treated on-site, by some combination of filtration (ultra- and membrane), chlorination, carbon beds, sand filters, flocculation, sedimentation, and dewatering. Any solid residues are disposed of as detailed above and waste water is discharged to a river.

3.3 Gaseous Wastes

Volatile emissions from solvents, storage tanks and process equipment, when not simply ventilated to atmosphere, are dealt with by a combination of bag filters, cyclones and activated carbon systems.

4.0 REGULATORY CONTROLS

The main environmental regulatory control at the site are the restrictions imposed on the discharges to the river (NRA consent limits). There are also obligations under the Control of Industrial Major Accident Hazards Pegulations 1984 (CIMAH) for the company to prepare and submit to the Health and Safety Executive a report of on-site emergency plans and the likely impacts on man and the environment of a serious accident.

5.0 POLLUTION CONTROL METHODS

Apart from the methods outlined in Section 3, there are on-site control systems for noise and odours.

The company (as part of the corporation) operates a waste minimisation scheme. This covers efforts to reduce the amount of waste generated by process changes and recycling/reuse. Many Corporate projects under this scheme have had payback periods of less than one year, including at this site a closed loop pumping system which substantially reduced the generation of waste-water. The scheme also includes assisting customers with waste/hazard problems eg, taking back used containers.

6.0 COMPANY POLICY

6.1 Environmental Management Policy

There is a Corporate environmental policy with an Environment, Health and Safety Committee composed of Board Members. The waste minimisation programme is given a high priority as are environmental issues generally. There is a manager for Environmental Affairs and 15 other staff who spend on average 25% of their time on environmental management tasks.

The company is organised as four plants: latex, polystyrene and two for agricultural chemicals. The plant manager has responsibility for the day-to-day operation of his/her plant including implementation of the environmental policy.

6.2 Training Policy

Training is the responsibility of each plant manager. Specific requirements are reviewed annually. The vast majority of training is carried out in-house and on-the-job, though short external courses are ocassionally used.

6.3 Environmental Training Policy

All staff are provided with information on the company's waste minimisation programme. Other environmental training is provided if a necessary requirement for the job eg, employees involved in waste management. In other words, environmental training is not generally separated out but included in general on-the-job training if considered relevant.

7.0 OCCUPATIONAL ANALYSES

Three occupational analyses are presented: the Environmental Manager, the Plant Manager for agricultural chemicals, and the Plant Process Engineer.

7.1 Environmental Manager

7.1.1 Tasks

All of this manager's time is allocated to environmental management. The core tasks are:

- Developing strategy and overall policy
- Advising Plant Managers
- Awareness of Legislation
- Awareness of Corporate requirements
- Liaison with regulatory authorities
- Liaison with Corporate Environmental Managers
- Chair of Company waste Management Committee

7.1.2 Skills and Competences

This job was created by the company 4 years ago. The Environmental Manager coordinates the environmental management activities of the four plants. He has overall responsibility for company environmental policy although implementation details are left to each plant manager.

The skills required for this position include: producing internal environmental audits; understanding of occupational health issues; a graduate science background; a good understanding of environmental issues; ability to deal with pressure groups; and supervisory and liaison skills.

7.1.3 Training

A new recruit for this job would be expected to be a graduate in a scientific discipline, have at least 6 years experience in related fields, some of it as an environmental management professional. The current job-holder has been on short courses to improve his environmental management skills.

7.2 Plant Manager

7.2.1 Tasks

Approximately 10% of each of the Plant Managers' time is allocated to environmental management tasks. The core tasks are:

- Developing plant environmental policy
- Making sure discharge consents are met
- Awareness of relevant legislation, particularly consents
- Awareness of Corporate requirements
- Financial implications of specific environmental management activities (eg, waste minimisation scheme)
- Training of staff
- Liaison with waste treatment plant officials
- Supervision of Plant Process Engineer.

7.2.2 Skills and Competences

A Plant Manager will be expected to have considerable plant experience, be a graduate engineer and probably have worked at other Corporation sites outside the UK. The environmental management tasks have been added to the existing tasks of the plant manager. He/she is not expected to have had any specific environmental training. Relevant information is provided by the Environmental Manager or other Corporate officials.

The general skills required are those expected of a manager of a large industrial facility: man-management, financial, technical etc.

7.2.3 Training

Environmental training is provided informally, as required. Skills are built up incrementally as company and corporate policies develop, often in response to legislation.

7.3 Plant Process Engineer

7.3.1 Tasks

Environmental management responsibilities constitute approximately 20% of the engineer's time. The core tasks are:

- Responsibility for waste management
- Implementation of waste minimisation projects
- Supervising operatives/fitters
- Documentation for waste arisings, audits and disposals
- Responsible for accident/spillage planning
- Implementing training programmes
- Member of Company Waste Management Committee

7.3.2 Skills and Competences

The job requires the skills of a graduate chemical or process engineer with several years of experience. No specific environmental expertise is required with the exception of a good knowledge of waste management/emission control technologies and legislation.

7.3.3 Training

Environmental training is given as required though is generally confined to new waste management practices and legislation.

8.0 FUTURE PROSPECTS

A general increase in environmental management is forseen as legislation and customer/public awareness increase. The waste minimisatiom programme is expected to expand and include more financial appraisal.

9.0 SUMMARY AND CONCLUSIONS

Company C1 is a division of a large multi-national chemical corporation. The company employs 270 people on a 75 acre site. The main products are agricultural chemicals (herbicides and insecticides), synthetic latex and polystyrene foams. A broad range of organic and inorganic chemicals are used in manufacturing. Large quantities of wastes are generated, particularly liquid wastes (1000 cubic metres per day) which are treated in an on-site facility. Solid residues are sent to off-site landfill and wastewater is disposed of to a river, subject to NRA consent limits.

Overall corporate environmental policy is formulated at Board level. The company has a full time Environmental Manager but day-to-day responsibility for environmental management is by the manager of each of the 4 plants at the site (latex, polystyrene, and two for agricultural chemicals).

Company training is mainly provided on-the-job and in-house as required by the specific job. However, all staff receive some training on the company's waste minimisation programme.

The Environmental Manager is a full-time employee with responsibility for assisting each of the four plants in developing and implementing its pollution control and waste management activities. He liaises both with Corporate (environmental) management and regulatory authorities. The job requires considerable environmental experience in industry as well as the general skills required of a science graduate at management level.

The Plant Managers are responsible for the day-to-day implementation of environmental activities in their plant, specifically making sure the plant operates within consent limits. Other environmental management responsibilities include staff training and supervision of the process engineer responsible for waste management.

The Plant Process Engineers are responsible for implementation of the waste minimisation schemes and direct supervision of operatives involved with the plant waste management activities. He/she also represents the plant on the company's Waste Management Committee.

Company C1's environmental management policy is well developed. The influence of the Corporation is evident as the waste minimisation programme is identical to that which was implemented almost 10 years ago at other Corporation companies. The company realises that activities will have to increase significantly over the next few years as legislation and public/customer pressures increase. However, there is not yet a significant programme of environmental training as it is assumed that the current practise, of integrating the environmental training into general on-the-job training, will continue.

CASE STUDY C2

Case Study C2 presents a medium-sized chemical manufacturing company which is a subsidiary of a large multinational corporation. The company produces a range of chemical products for a number of industries including the rubber, pharmaceutical and herbicide industries.

A number of wastes are produced, the largest component of which is waste-water which is treated on-site at the waste-water- treatment-unit. Waste-water is discharged to a Class 1A river and the company is thus subject to unusually strict consents.

The company's parent company considers itself to be pro-active in its environmental management . It has a written environmental policy which details environmental targets which are often beyond the legislative requirements of the countries in which the subsidiaries operate.

The company does not have a formal education and training policy. Training is provided as and when required and is provided informally, on-the-job, or formally in-house. Personnel of all categories would be sent on short courses if they were relevant to the operations of the company. The company considers environmental awareness among its staff to be important and considers all personnel to have some responsibility for environmental management.

The main changes that have occured as a result of increased environmental management activities have been an increase in the level of monitoring and an increase in the level of company liaison with external bodies. The company is planning to increase the provision of training across all categories of staff.

The case study presents an occupational analysis of three jobs; Operative, waste treatment unit; Superv. r, waste-treatment-unit; and Manager, Health and Safety.

Occupational Analysis

	Operative (w.w.t.u.)	*Supervisor (w.w.t.u.)*	*Manager Health and Safety*
Tasks	monitoring incoming and out-going waste streams; operating micro-processor controls; operating testing equipment.	providing technical advice on the waste water treatment unit; responsibility for maintaining the unit; providing training to operative staff; ensuring quality contol.	keeping up-to-date, and ensuring compliance with legislation; liaising with regulatory bodies; providing advice to external policy makers; promoting environmental best practice;responsibiltiy for training.
Skills and Competences	knowledge of the operation of the plant; knowledge of materals used in manufacturing; knowledge of consents; knowledge of environmental policy	knowledge of plant operations; knowledge of manufacturing; knowledge of consents and company regulations; interpretation skills; appreciation of environmental issues and consents, pollution control technology.	detailed understanding of the chemical and engineering processes;detailed knowledge of legislation; knowledge of pollution control technology; understanding of the environmental impacts of processes; strong interpersonal skills.
Training	No formal pre-entry training is required. Post-entry training is provided primarily on-the-job.	No formal qualifications are required; experience as a laboratory technician Post-entry will be provided primarily in-house.	Chemistry or Engineering degree; environmental expertise can be acquired post-entry on- the -job or through formal external and in-house training.

CASE STUDY C2

1.0 THE COMPANY

Case Study C2 presents a medium-sized chemical manufacturing plant which is a subsidiary of a large multinational corporation. Manufacture of chemicals has has been carried out at the site since 1922 although under its present ownership since 1928. The plant produces 45,000 metric tonnes of chemical products per annum and it employs 490 staff.

2.0 INDUSTRIAL PROCESSES AND PRODUCTS

2.1 Processes

There are 30-40 raw materials used at the plant, examples of which include: phenol anilene; sulphur monochloride; chlorine; sulphuric acid; hypochlorite acid and caustic soda.

There are twelve different manufacturing processes carried out at the plant. However, they are all batch processes and follow the same form (there are no continuous processes):

1) Reaction Stage: liquid raw materials pass through the reaction stage at low pressure to form the product which is carried in solution or suspension

2) Separation Stage; crystalises or filters out the solids

3) Drying Stage; the product is wet once it passes through the separation stage so it is dried in air using thermo-venturi or fluid bed dryers.

4) Grinding; a proportion of the finished products are ground in order to obtain a practicable particle size

5) Packaging; the finished products are usually packed in 25 kg bags

2.2 Products

The plant produces a range of chemicals for a number of industries ; namely the rubber, pharmaceutical and herbicide industries. Rubber Chemicals constitute sixty per cent of total output. In general the finished products are non-hazardous although they may be flammable.

3.0 WASTES AND POLLUTION

3.1 Solid Wastes

Solid Wastes produced as a by-product of the production process include:

- pitch from distillation activities (30-40 tonnes pa)
- contaminated finished products
- filter cake
- sludge (surplus from the waste water treatment unit)

A large proportion of the pitch is disposed of to landfill. However, a small percentage is hazardous and is incinerated at merchant facilities. Contaminated finished products and filter cake are disposed of to landfill. The sludge, which is innocuous, represents the largest component of waste material from the plant. Ten thousand tonnes per annum are shipped out from the plant in liquid form to a filtration operation. The resulting filter cake is disposed of to landfill.

3.2 Liquid Wastes

The main liquid waste is waste-water which is discharged, after passing through the biological waste-water treatment unit, to the local river (5000 cubic metres per day). Liquid solvents, which are produced as a by-product of the production process, are shipped out of the plant for incineration (200 tonnes per day).

3.3 Gaseous Wastes

Sulphur dioxide is emitted from the boiler-house and also from one of the manufacturing processes. There are also microscopic dust and solvents emitted from the drying area. The plant is currently establishing an air monitoring group which will seek to identify and characterise emissions from the various stacks. To date the environmental management practised in this area has been very limited.

3.4 Noise and Odours

There is continual background noise at the manufacturing site. However, noise only represents an external problem where an unusual activity is being carried out on site; eg, a response to a blockage. Noise minimisation is practised on the site. Coal, for example, is transferred during the day and not at night in order to minimise disturbance.

The company receives very few odour complaints. In general these problems arise infrequently and are a result of anomalies in the production process.

4.0 REGULATORY CONTROL

The river to which the plant discharges its waste water is Class 1A (provides fishing and the local water supply) and is thus subject to very strict control. The staff at the site take daily samples from the river, both down-stream and up-stream, and, less frequently, sample from small tributaries. The National Rivers Authority sample at least weekly. The licence to extract water from the river is costed on the basis of an estimated maximum annual useage. The consents for discharge are unusually strict: BOD 30mg per litre; COD 250mg per litre; suspended solids 9.5 mg per litre; phenols 0.2mg per litre.

Domestic waste water and leachate from the land-fill are discharged to local authority sewers. The consent limits for discharge to sewer are; COD 2000 mg per litre; suspended solids 1000 mg per litre ; total metals 10 mg per litre ;and mercury 0.1 mg per litre.

5.0 POLLUTION CONTROL METHODS

A wide range of pollution control equipment is used at the plant. Examples include:

- Dust-filters for dust collection
- filter-bag system in the boiler-house
- scrubbing units; venturi scrubbers; caustic soda or water as a medium; (one process uses incoming raw materials as the scrubbing medium)
- distillation columns
- liquid extraction
- waste-water treatment
- monitoring equipment for rivers (down-stream and up-stream)

A programme for monitoring emissions to atmosphere is currently being implemented at the site which will result in the installation of appropriate pollution control equipment.

In terms of the quantifiable economic benefits resulting from the implementation of pollution control equipment, most of the equipment was in-built into the process, hence the benefits are difficult to quantify. However there has been a recent example where changing the catalyst in a process resulted in a reduction in waste generation with associated cost savings.

6.0 COMPANY POLICY

6.1 Environmental Management

The company must adhere to the Group environmental policy which has been applied world-wide across the corporation. The parent company considers itself to be pro-active in terms of environmental management and has established company emission targets which are lower than national legislation demands.

The main factors contributing to the formulation of this environmental policy were; impending or current legal requirements; the importance of environmental matters in their own right and, increasingly, public awareness.

The main emphasis of the company's pollution control/environmental management activities is waste-water management, both on-site and off-site. However the company is currently implementing a programme for monitoring emissions to atmosphere which will involve characterising the emissions from each process on site. Risk assessments are carried out as a matter of course, prior to the implementation of new projects. These take the form of a qualitative statement rather than a quantified analysis.

6.2 Training

There is no formal training and education policy. Training is provided irregularly, as and when required, across all categories of staff. It is the responsibility of the line-manager to ensure that training is provided to staff when necessary. Time is preceived to be the main constraint on the up-take of training.

Training is provided informally, on-the-job, or by formal, in-house methods. However personnel of all categories would be sent on a short-course were it considered to be appropriate. The company is of the view that training should take place in work time rather than in the employee's own time. Hence the company does not generally view distance learning packages as being a useful method of training.

6.3 Environmental Training

There is no environmental training policy. However, all personnel on site are assessed to have received some form of environmental training in the last two years.

7.0 OCCUPATIONAL ANALYSIS

In the case of this company, cultural and attitudinal characteristics of the personnel towards environmental management are driven from the top. Hence all categories of staff are considered to be involved in environmental management. However, functionally, specific responsibilities for environmental management lie with working groups comprising staff ranging from technical specialists to operatives. The manufacturing unit, for example, takes responsibility for the

quality of the discharge stream to the waste-water treatment unit and for the environmental control equipment; eg, the bag-filters and the scrubbing equipment. The company has recently established an air monitoring group which will comprise 3 or 4 personnel with experience of analytical sampling.

This section presents an occupational analysis of three personnel concerned with core environmental tasks and details the extent to which the tasks involved in the job have changed as a result of increased attention to environmental management.

- Operative, Waste Water Treatment Unit
- Supervisor, Waste Water Treatment Unit
- Manager, Health and Safety and Environment.

7.1 Operative, Waste Water Treatment Unit

All of the operative's time is allocated to environmental management tasks. The operative reports to the Supervisor of the Waste Water Treatment Unit. The operative is responsible for operating the waste water treatment unit and is an expert in the operation of this particular piece of plant. There have been changes in the tasks performed in the job resulting from a switch from manual control of operations to the use of micro-processers. There has also been an increase in the amount of the operative's time allocated to monitoring and analyses, in accordance with the company's policy to improve environmental management.

7.1.1 Tasks

The core environmental tasks relating to environmental management include:

- monitoring in-coming waste-water streams
- balancing input load to treatment operations
- monitoring output streams
- operation of micro-processor controls; valves, pumps, agitators
- operation of testing equipment

7.1.2 Skills and Competences

The skills and competences required to carry out the tasks include:

- specific knowledge of the requirements of the unit's operations
- knowledge of the materials relating to the plant
- knowledge of environmental consents
- knowledge of company environmental policy
- analytical abilities

7.1.3 Training

No formal pre-entry training is required. Numeracy and literacy are essential. Post-entry training will be provided mainly on-the-job although it would be supplemented by formal training provision if appropriate.

7.2 Supervisor, Waste Water Treatment Unit

All of the supervisor's time is allocated to environmental management tasks. The supervisor of the waste water treatment unit has responsibility for the day-to-day operations of the plant and for the supervision of operative staff. He reports to the Manager for the Environment, Health and Safety. There have been no additional tasks resulting from increased environmental awareness. However following the drive towards improved environmental standards the proportion of time allocated to analytical and monitoring tasks has increased significantly. This has been accompanied by measures to improve the quality of operative staff in order to facilitate the increased devolvement of responsibility to operative level and therefore contribute to a general rise in standards. These measures include a more rigorous selection procedure and greater attention to training requirements.

7.2.1 Tasks

Specifically, the core environmental management tasks include;

- provision of technical advice on the maintenance and operation of the unit
- ensuring that the necessary tools and equipment are available to the operative staff
- responsibility for ensuring that the operative staff are provided with the necessary training
- responsibility for quality control of in-coming and out-going waste streams
- responsibility for liaising with the manufacturing line on incoming waste stream quality.

7.2.2 Skills and Competences

The skills and competences required to carry out these tasks include;

- a comprehensive understanding of the unit's operations
- knowledge of the manufacturing process
- knowledge of environmental legislation and consent levels
- knowledge of company regulations regarding effluent discharge levels
- general understanding of the potential environmental impacts of the operations
- knowledge of environmental protection technology
- ability to interpret sampling reports and to identify and rectify problems

7.2.3 Training

No formal pre-entry training is required. However the supervisor is likely to have had experience working as a laboratory technician carrying out analyses of samples. Experience and man-mangement skills are two essential pre-entry requirements for the job. The supervisor will be

provided with post-entry training as and when required using informal on-the-job training, formal in-house training or short courses if appropriate.

7.3 Manager, Health and Safety and Environment

Seventy per cent of the Manager for Health and Safety and Environment's time is allocated to environmental management tasks. The post-holder has overall responsibility for environmental issues at the site. He reports to the Plant Manager. There have been no additional functions to the job as a result of increased environmental awareness. However, there has been a significant increase in the amount of time allocated to environmental affairs. This reflects the changing priorities of the company regarding the practice of environmental management as against the requirements of manufacturing. The importance attached to liaison with the local community has increased significantly. This has been the company's response to the growing level of environmental awareness amongst the general public.

7.3.1 Tasks

The core environmental management tasks include:

- legal and policy advice: responsibility for ensuring that the company is aware of developments in EEC, national and corporate legislation and environmental policy and for ensuring that the staff are adequately informed and that environmental standards are adhered to

- liaison officer: liaising role with external bodies eg, the regulatory bodies or the local community bodies; attendance at seminars, conferences and speaking on behalf of the company or the industry

- advisor; responsible for providing input to government consultation papers or trade association documents

- promotion of environmental best practice throughout the plant given the constraints within which the manufacturing unit must operate

- training; providing information on environmental training and identifying the training needs of the staff.

7.3.2 Skill and Competences

The skills and competences required to carry out these tasks include:

- a detailed understanding of the chemical and engineering processes carried out on-site
- a comprehensive understanding of the treatment and control processes carried out on-site
- in-depth appreciation and understanding of legislative requirements
- strong communication skills
- understanding of the potential environmental impacts of the raw materials, products and processes carried out on-site.
- knowledge of pollution control technology

7.3.3 Training

No formal training in environmental affairs is required for the job. The post-holder must possess a degree in an engineering or scientific discipline. A traditional scientific background is perceived to be essential. Specific knowledge of the environment can be acquired either on-the-job, or by the up-take of formal training; attendance at seminars, conferences, short courses. It would be useful if the post-holder had acquired pre-entry experience of working in the environmental field. However there is no perceived need for a specialist in environmental science.

8.0 FUTURE POLICY

The company is planning to increase its environmental management activities in all areas. The parent company has recently pledged to reduce the level of total emsissions from its subsidiaries by 75% by 1995. The company has responded to this by establishing an air monitoring group at the site and expects to increase its resource allocation in this area. The company has also planned a large expenditure to replace its waste water treatment unit.

The company intends to increase the provision of training across all categories of staff.

9.0 SUMMARY AND CONCLUSIONS

The company is a medium-sized chemical manufacturing plant which is a subsidiary of a large multinational company.

The company produces a range of chemical products for a number of industries including the rubber, pharmaceutical and herbicide industries.

A number of wastes are produced as a by-product of the production process, the largest component of which is waste water which is treated on site at the waste water treatment unit. The waste water is discharged into a Class 1A river and is therefore subject to unusually strict consent levels.

The company's parent company considers itself to be pro-active in its environmental policy. The parent company has a written environmental policy which details environmental standards which are often above the legislative requirements of the countries in which the subsidiaries operate.

To date, the main emphasis of the company's pollution control activities has been waste water treatment and waste disposal. However, in line with the parent company's requirements the company is currently increasing the level of resources committed to monitoring emissions to atmsophere.

Regarding training, there is no formal training and education policy. Training is the responsibility of the line manager and is generally provided informally on-the job or by formal in-house methods. Short courses would be available for all categories of personnel were an appropriate course available.

The company is of the view that it is important that its personnel are environmentally aware and has actively promoted environmental awareness throughout the company.

The company considers all its personnel to be involved in, and have responsibilty for, environmental management. Specifically the case study carried out three occupational analyses: Manager, Health and Safety and the Environment; Supervisor, Waste Water Treatment Unit; and Operative, Waste Water Treatment Unit.

The operative is an expert in the operation of the plant. He reports to the supervisor of the waste water treatment unit. The operative does not require any pre-entry qualifications or experience but will receive post entry training primarily on the job. He is required to have a knowledge of the operating parameters of the plant; temperature, pH, consents, but otherwise does not require any environmental knowledge. The operative's job has changed in that traditional manual operations are now micro-processer controlled. An increasing proportion of the operative's time is allocated to monitoring and analyses.

The Supervisor of the Waste Water Treatment Unit has responsibility for the day-to-day operation of the plant and for the supervision of the operative staff. A greater proportion of the supervisor's time is now allocated to monitoring and analyses in accordance with the drive towards quality control and improved environmental management. The supervisor is responsible for the provision of training to operative staff. The supervisor is required to have experience in sample analysis. He is not required to have pre-entry formal training in the environmental field. In-house post-entry training will be provided, supplemented by short courses as required.

The Manager for Health and Safety and Environment has overall responsibility for environmental affairs. The company has had a longstanding environmental policy, hence there are no recent examples of new tasks being incorporated into the job. However during the last five years there has been a significant change in the priorities of the job. For example the amount of time allocated to liaison with the local community has increased significantly as the company has responded to growing public awareness and concern over the environment. The primary role of the Manager for Health and Safety and Environment is an advisory one, both on legislative issues and in the promotion of environmental best practice on site. The company is of the view that the combination of responsibilities for Health and Safety and the Environment within one post is useful as the factors and issues that affect health and safety in the internal environment often impinge on

the external environment. The post-holder is required to hold a degree in a traditional scientific discipline. Formal training in environmental science is not a requirement although pre-entry experience of working in the environmental field would be useful.

The company has attached a high prority to environmental management both in recognition of its inherent importance and in response to growing public concern. The company benefits from belonging to a large Group whereby it can gain from the experience of other subsidiaries and draw on Group expertise.

CASE STUDY C3

Case Study C3 presents a medium-sized chemical manufacturing company which is a subsidiary of a large multinational corporation. Chemical manufacture occurs at two sites. The company produces a range of fine chemicals as intermediate products for a number of industries including the pharmaceutical, agro-chemical and dye-stuffs industries.

Manufacturing produces a number of wastes including: solid waste residues; aqueous wastes containing inorganic substances and organic contaminants; and gaseous wastes, carbon dioxide, sulphur dioxide and volatile aromatic gases.

The company has an environmental policy which is incorporated into its Health and Safety policy. To date, the main focus of the company's environmental management activities has been the treatment of aqueous wastes . However as a result of the detection of phenol contaminated soil and ground-water on-site and in response to increasing pressure from the parent company to produce emission statistics, the company is currently undertaking an extensive monitoring and analysis programme.

The company does not have a formal education and training policy. Training is provided primarily in-house although management may be sent on short courses. There is no environmental training policy. However, an estimated 75% of personnel are assessed to have received environmental training awareness in the past two years.

The case study presents an occupational analysis of three jobs; the Effluent Plant Operative; the Energy/Effluent Manager; and the Senior Chemist for the Environment.

Occupational Analysis

	Effluent Plant Operative	*Energy/Effluent Manager*	*Senior Chemist*
Tasks	operation of the effluent plant; temperature, flow rate and nutrient control; analytical testing, sampling and analysis of in-coming and out-going waste streams	running the boiler house; responsibility for waste disposal; liaising with regulatory bodies; management of operative staff; providing technical input to research on waste disposal methods	developing sampling and analytical techniques; improving efficiency of biotreatment plant; process research regarding waste minimisation; research into new methods of treating waste streams; supervision of laboratory staff; auditing and quantification of emissions
Skills and Competences	numeracy/literacy, knowledge of consents, process limits ie temp and max feed-rate; knowledge of the drainage system in order to contain spillages, deal with accidents	understanding of the manufacturing processes; detailed knowledge of waste disposal legislation and legislation governing levels of discharge; knowledge of energy issues; knowledge of waste disposal technologies; background in environmental issues; man-management skills	understanding of micro-biology; strong skills in analytical chemistry; understanding of the manufacturing processes carried out at the site; knowledge of pollution control, waste-treatment and monitoring technologies.
Training	No formal qualifications are required. Post entry training is provided primarily on -the-job	degree in chemistry or engineering; ten years experience in chemical waste management, water or energy indusrties. Post-entry training will be provided primarily in-house . The post-holder may be sent on short courses on waste management	degee in chemistry; ten years experience as an industrial chemist. Formal training in environmental science is not required although a background in the subject is useful

CASE STUDY C3

1.0 THE COMPANY

Case Study C3 presents a medium-sized chemical manufacturing company which is a subsidiary of a large multinational corporation. Manufacturing is undertaken at two different operating sites. The information presented in this case study relates to both sites. Chemical manufacturing has been carried out at the sites since 1950. The plants have been operating under present ownership since 1983. The company employs 330 permanent staff and an average of 50 additional cntract staff.

2.0 INDUSTRIAL PRODUCTS AND PROCESSES

2.1 Processes

A wide range of raw materials are used in the manufacturing processes. Typically these include: methanol, toluene and propylene

There are a variety of manufacturing processes at the plants. These include:

- batch liquid and vapour phase catalytic reactions
- sulphonisation and caustic fusion
- crystalisation and high efficiency batch and continuous fractionation
- liquid phase ring closures
- high temperature catalytic synthesis

2.2 Products

The plants produce approximately 40 different intermediate chemical products, in highly variable volumes, for a number of industries including the pharmaceutical, agrochemical and dye-stuffs industries. There are three broad groups of product; alkyl phenols, thiophens and derivatives, and pyridenes and derivatives. These three groups account for 80% of output. Specific examples of product include:

- phenol; sold in different grades for a variety of applications including resins, bisphenols and salicylates
- dichlorophenol; used as a veterinary and pharmaceutical intermediate
- o-cresol; used in the production of selective herbicides
- p-cresol; used in the production of antioxidants, pharmaceuticals and dyestuffs
- alkyl aromatics; used in the pharmaceutical industry
- vinyl pyridenes: used in the oil and dye industries.
- pyridenes: used in the production of pharmaceuticals, herbicides and bactericides.
- sulphite: used in the paper pulping industry

The products are all fine chemicals defined as low volume, high value and are used as intermediate chemicals; ie further reaction must take place before the final product is produced.

3.0 WASTES AND POLLUTION

3.1 Solid Wastes

There are relatively few solid wastes resulting from the manufacturing process. The main solid wastes are residues, the largest component of which is phenol. Ninety per cent of the residues produced are incinerated on site. Vinyl pyridene residues, however, present a problem because they are toxic and cannot be incinerated. These residues are disposed of to land-fill off-site. The plant is presently investigating methods of cutting out vinyl pyridene at source or of mobilising it (within the process) in order that it may be incinerated in some other form. Sodium sulphite is produced as a by-product which is sold.

3.2 Liquid Wastes

Liquid wastes consist mainly of aqueous wastes containing inorganic substances, such as salts from neutralisation, and organic contaminants such as methanol, phenols and pyridenes. These aqueous wastes are treated by the three biotreatment plants operating on site; one treats all the surface water from the site, which is then discharged to the water course, and the other two treat all process liquid waste, which is then discharged to the sewers.

3.3 Gaseous Wastes

All toxic gases are scrubbed using mainly wet scrubbers which use caustic soda or sodium hypochlorite as the medium. The main emissions to atmosphere are carbon dioxide and sulphur dioxide, which are emitted from the boiler house where heavy fuel is burnt, and volatile aromatic gases. Pyridene vapours are collected in a vent system and incinerated in the boiler-house.

3.4 Odour and Noise

Odour is not generally a problem at the plant although pyridene has potential for causing problems. Noise presents an internal health and safety issue but does not affect the external environment.

4.0 REGULATORY CONTROLS

All discharges to sewer are subject to consent levels. The plant is subject to Health and Safety regulations. NRA, HMIP and HSE respectively visit the sites every 6 months.

5.0 POLLUTION CONTROL METHODS

There is a variety of pollution control equipment operating on-site. Increasing emphasis is given to the monitoring of emissions. Examples include:

Emissions control;

- biotreatment for waste water; this is the main pollution control activity
- wet scrubbers (caustic soda or sodium hypochlorite medium)

Monitoring;

- gas chromatography
- kit for measuring total suspended solids
- personal and locational sampling techniques; to measure individual exposure to emissions and emissions to atmosphere
- monitoring of soil and ground-water on site for phenol contamination

6.0 COMPANY POLICY

6.1 Environmental Management

The company's environmental policy is incorporated into its health and saftey policy and includes statements relating to;

- procedures to deal with potential hazards for personnel and the environment
- commitment to the best practicable means to prevent pollution of air, water and soil and to protect animal life from the adverse affects of its operations
- support and conduct research directed towards increased conservation of the environment

The company has set up an environment committee. The emphasis given to environmental management has greatly increased over the past five years. This is partly in recognition of the importance of environmental issues in their own right but more recently due to the information requirements of the parent company which is carrying out a rigorous analysis of emissions from its various subsidiaries and is demanding formalised, quantified data.

The main emphasis of pollution control activity at the site is waste-water treatment. However, increasingly, the company is concentrating on the environmental management of air and land. A system for monitoring emissions to atmosphere has been implemented using personal and locational sampling techniques. These measures have been introduced as a response to both the Control of Substances Hazardous to Health Regulations 1988 (COSHH) concerning the level of exposure of personnel and to increasing concern regarding the polluting effects of production on the external environment. The company is currently carrying out on-site monitoring of soil and ground water contaminated with phenol.

Environmental mangement is viewed as an integral part of operations on-site. Hazard and operability studies of all new processes are carried out and a programme to assess the technical integrity of existing plant is in operation. The plant has also commenced a programme of environmental auditing which is carried out using in-house personnel.

6.2 Training

The company does not have a formal education and training policy. Responsibility for training lies with line management. Job-specific training is provided as and when required. The company has recently implemented BS 5750 (British Standards Institute's Quality Assurance Scheme) and has also started to introduce Total Quality Management. Implicit in these is the recognition of the importance of training in improving overall quality. As part of its objective of improving standards, the company is aiming to devolve more responsiblity to operative level, supported by an increase in the provision of training. The five year plan has allowed for one extra man per four man shift in order to facilitate personnel being released for training.

The main method of training is on-the-job or in-house, usually provided by in-house expertise. If appropriate, external experts are brought in to run short courses. The company is presently negotiating with a University to run a City & Guilds course in-house. External training is provided at managerial level but not at operative level. Generally, external training is provided by commercial companies.

The content of training is dependent on the requirements of the job. Whilst the company is prepared to send personnel on courses on specific subjects, eg The Environmental Protection Bill, it would be unlikely to send personnel on more general training courses.

6.3 Environmental Training

The company does not have a formal environmental policy. Environmental training is provided according to the needs of the job. Fifty per cent of formal external training undertaken relates to legislation. It was stated that it is increasingly difficult to distinguish environmental training from health and safety training and training which is required simply to carry out the job.

7.0 OCCUPATIONAL ANALYSIS

Whilst over-all responsibility for environmental affairs at the two plants lies with the Technical Director, functionally, line responsibility lies with each Site Director.

There are a number of personnel on site who are involved in environmental management. This section will present an occupational analysis of three jobs :

- The effluent plant operator
- The energy effluent manager
- The senior chemist for the environment

7.1 The Effluent Plant Operator

The effluent plant operator reports to the energy/effluent manager. All of his time is allocated to environmental management tasks. There have been no additional tasks incorporated into the job as a result of increased environmental managment practices. However, greater emphasis is now placed on the monitoring/analysis aspect of the job.

7.1.1 Tasks

The core environmental tasks include;

- operation of the effluent plant; temperature, flow rate and nutrient control,
- analytical testing: sampling and analysis of in-coming and out-going waste streams

7.1.2 Skills and Competences

- numeracy and literacy
- knowledge of consents
- basic understanding of the interactions between waste-streams and bacteria in the biotreatment plant
- knowledge of the process limits, eg the temperature range and maximum feed-rate
- knowledge of the variables of control
- knowledge of the drainage system in order to contain spillages, deal with accidents
- interpretation of results of analysis

7.1.3 Training

No formal pre-entry qualifications or knowledge are required. The post-holder will be given post-entry training, mainly in the form of on-the-job training supplemented by more formal in-house training.

7.2 Energy/Effluent Manager

Sixty per cent of the Energy/Effluent Manager's time is allocated to environmental managment. In the last five years the balance has shifted towards environmental matters. An example of a new task, which has been incorporated into the job as a result of the company's objective of improving environmental management on-site, is the drive to develop more in-house treatment of waste. The energy/effluent manager provides the technical input to waste treatment research and works closely with the senior chemist. Increasingly more of the energy/effluent manager's time is allocated to waste management tasks.

7.2.1 Tasks

The core tasks relating to environmental management are;

- responsibility for running the boiler house
- responsibility for all off-site waste disposal
- liaision with the regulatory bodies
- management of operative staff
- technical input to research on waste diposal methods

7.2.2. Skills and Competences

- Ten years experience in a related field; energy, water or waste management
- understanding of the plant's operations and manufacturing processes on site
- extensive knowledge of environmental legislation particularly relating to waste disposal and consent levels
- knowledge of energy issues; energy plant and energy efficiency
- man-management skills
- knowledge of waste disposal technologies
- knowledge of general environmental issues

7.2.3. Training

Pre-entry requirements are a degree in chemistry or engineering and ten years experience in either the chemical, waste management, water or energy industries. Specifically, previous experience would essentially have consisted of a strong element of chemistry. It is likely that someone coming into the job would have expertise either in energy or in waste disposal but would be unlikely to have experience in both. The company will provide post-entry training, both on-the-job and in-house to develop the expertise and, if appropriate, would send the manager on short-courses on specific subjects particularly relating to waste disposal legislation.

The company expects the environmental component of the job to increase in importance. However, it is not perceived that there is a need for an environmental specialist, but rather that the function will best be performed by a technical scientist who has developed expertise in the environment, either on-the-job or through formal means of pre-entry or post-entry training.

7.3 Senior Chemist (Environment)

All of the Senior Chemist's time is allocated to environmental management tasks. There have been two new tasks integrated into the Senior Chemist's job as a result of stricter health and safety regulations and of increasing environmental management practices at the site; the first is the development of methods for personal monitoring (COSHH) and locational monitoring to assess emissions to atmosphere and the second is the development of methods for soil sampling and analysis following the discovery of phenol contamination in the soil and ground-water on site.

7.3.1. Tasks

- developing sampling and analytical techniques; particularly relating to soil, groundwater and personal monitoring (COSHH)
- improving the efficiency of existing biotreatment plant
- process research into waste minimisation at source (clean technologies)
- investigation of new methods of treating waste streams

- supervision of laboratory personnel
- membership of the company's environmental committee
- auditing and quantification of emissions

7.3.2 Skills and Competences

- ten years pre-entry experience
- understanding of micro-biology
- strong skills in analytical chemistry
- understanding of the manufacturing processes carried out at the site
- comprehensive knowledge of available pollution control, waste treatment and monitoring technolgies

7.3.3 Training

The pre-entry requirements for the post are a degree in chemistry together with ten years of experience working as an industrial chemist. A general background in environmental issues is necessary but formal training in the environment is not a perceived requirement.

8.0 FUTURE PROSPECTS

The company is expecting to increase its environmental management activities particularly in the areas of soil pollution control and environmental impact assessments. The detection of phenol contamination in the soil and ground-water has initiated an extensive monitoring programme which is expected to expand. The environment committee has implemented a programme for conducting environmental impact assessments.

The company is aiming to increase training provision across all categories of staff. The company recognises the important role training will play in increasing overall standards on site. The main constraint on the up-take of training is time and the lack of subject specific short courses.

The majority of training will be carried out informally, on-the-job or formally in-house using either in-house personnel or external expertise. However, if there are courses dealing with a specific subject of relevance to the company's activities, then senior personnel may be sent on short courses.

9.0 SUMMARY AND CONCLUSIONS

The company is a medium-sized chemical manufacturing company which is a subsidiary of a large multinational corporation. Chemical manufacture takes place at two operating sites which produce a range of fine chemicals as intermediate products.

There are a variety of manufacturing processes on-going at the sites including both batch and continuous processes Three main groups of product account for 80% of output; alkyl phenols, thiophens and derivatives and pyridenes and derivatives. These products are produced for a variety of industries including the pharmaceutical, agrochemical and dye-stuffs industries.

A number of wastes are produced as a result of the manufacturing process including solid waste residues, aqueous wastes containing inorganic substances and organic contaminants and gaseous wastes; carbon dioxide, sulphur dioxide and volatile aromatic gases.

The company's environmental policy is incorporated into its Health and Safety policy. To date, the main focus of the company's environmental managment practices has been the treatment of aqueous wastes. However as a result of the detection of phenol contaminated soil and ground-water on-site and in response to increasing pressure from the parent company to produce formalised emissions statistics, the company is currently undertaking an extensive monitoring and analysis programme.

The company does not have a formal education and training policy. However training is the responsibility of line management and is provided as and when required, usually by informal, on-the-job training or by formal, in-house training using in-house personnel or external expertise. Management may be sent on a 2 day short course were it perceived to be of particular value.

There is no specific environmental training provided by either formal or informal methods. However an estimated 75% of personnel are assessed to have received environmental awareness training in the context of the potential environmental impacts of the tasks they carry out. The company does not foresee there being any separate policy for environmental training, but rather will provide environmental training in the context of a general training programme.

The company views an increase in the level of training as instrumental to improving overall quality at the site. The company expects to increase the level of responsibility devolved to operative staff.

Section 7 presents an occupational analysis of three jobs : the Effluent Plant Operator, the Energy/Effluent Manager and the Senior Chemist for the environment

Whilst all of the Effluent Plant Operator's time is allocated to environmental management tasks, the knowedge requirements of environmental affairs is minimal. The operative is required to understand the technical and legal parameters within which the plant must operate; eg temperature, pH, consents. These knowledge requirements are specific to the operation of the plant and there is no requirement for an environmental background. Although the operative must now pay increased attention to monitoring and analyses tasks, this trend is repeated across the company and reflects the increasing priority given to environmental management.

Sixty per cent of the Energy/Effluent Manager's time is allocated to environmental management tasks. The proportion of time allocated to waste management, has increased significantly in the past five years. In particular, the increasingly complex legislation governing waste diposal demands increasing amounts of time. The Energy/Effluent manager is required to have an understanding of environmental issues but not necessarily to have had formal training in the subject. It was stressed that although the company expects the environmental component of the job to increase, a specialist in the environment in not required. Rather, the post-holder should be a scientist.

All of the Senior Chemist's time is allocated to environmental management tasks. The Senior Chemist for the environment heads up the laboratory research team which has responsibility for developing sampling and analytical techniques and for carrying out process research into waste minimisation and efficieny improvements. The Senior Chemist must have a comprehensive understanding of the manufacturing processes carried out at the site and must have a strong background in analytical chemistry. Whilst a firm grounding in environmental affairs is required, formal training in environmental science is neither necessary nor sufficient. A degree in chemistry is an essential requirement.

Although the company considers environmental management to be a priority within industry, it does not perceive a need for an increased number of environmental science graduates. Rather it is of the view that an environmental option should be incorporated into traditional science university courses and that there should be a wider availability of specific short-courses of relevance to industry which would assist post-entry environmental training. The company is very aware of the increasing demands for improvements in environmental management and is responding appropriately.

CASE STUDY C4

Case study C4 presents a chemical company which is the dye-stuffs and chemicals division of a large multinational corporation. The company employs 200 staff and has an annual turn-over of £60 million.

The company functions as a distribution site, providing warehouse facilities for storage and re-packing. The company receives deliveries of chemicals, dye-stuffs and pigments from the corporation's UK and European manufacturing sites. These are stored in the warehouses before delivery to customers by road. Some of the chemicals are re-packed at the the site.The dye-stuffs and chemicals are mainly used in the leather and textile industries.

The main solid waste is packaging which has been returnad to the company by customers. There is an increasing expectation on the part of customers that suppliers should dispose of waste on their behalf. The packaging is washed at the site and is then disposed of to landfill. Some packaging is returned to the manufacturing plant for re-use. Liquid wastes constitute the main waste component. Approximately 20 tonnes of liquid waste chemicals are exported off-site for incineration. Waste-water is discharged to sewer and is subject to a series of consents governing pH, metals, particulates, fats and greases.

The majority of pollution control equipment installed relates to hazard prevention; the control of spillages and the prevention of fire.

The company must comply with the Group environmental policy which details a commitment to safeguarding the environment by incorporating environmental protection into the corporation's mainstream activities.

The company has a formal training policy which is governed by corporate policy. Environmental isssues are included in the company's education and training policy, both because of the demands of legislation and because of the benefits to the company. Increasingly customers expect suppliers of chemicals to assist them with pollution problems that may arise from the use of their products. Hence environmental management activities are being promoted on-site and "downstream". Company personnel are therefore being provided with environmental training both in-house and through the use of short courses, in order to provide advice and training to customers.

The case study presents occupational analyses of two jobs: Health, Safety and Environmental Protection Manager; and the Warehouse and Distribution Manager.

Occupational Analysis

	Health Safety and Environmental Manager	*Warehouse and Distribution Manager*
Tasks	liaising with water company over consent levels; ensuring compliance of discharges with legislation; responsibility for waste disposal; providing product safety data to the customer(handling procedures and known hazards); advising on environmental, health and safety matters; attendance at health and safety and environment meetings	responsibility for the prevention and control of spillages; responsible for ensuring product segregation; training staff; testing systems to ensure correct functioning
Skills and Competences	knowledge of health and safety legislation relating to chemicals; knowledge of waste disposal legislation; broad knowledge of chemicals; knowledge of consents; knowledge of environmental impacts of chemicals; report writing/ presentation skills; man-management skills	experience in the industry; a high level of man-management skills; knowledge of hazardous characteristics of chemicals; knowledge of legislation regarding health and safety and the transportation of chemicals.
Education and Training	degree in chemistry or physics; ten years industrial experience; experience in laboratories; post-holder will attend short courses and seminars.	no formal qualifications are required for the job; work experience and experience relating to the transportation of chemicals are essential.

CASE STUDY C4

1.0 COMPANY

Case Study C4 presents a chemical company which is a subsidiary of a large multinational chemical corporation. The company employs 200 employees.

2.0 INDUSTRIAL PROCESSES AND PRODUCTS

2.1 Processes

The division does not carry out manufacturing but rather functions as a distribution site providing warehouse facilities for storage and re-packing. The company receives, by road, deliveries of chemical, dyestuffs and pigments from the corporation's UK and European manufacturing sites. These are stored in the warehouses before delivery to customers by road. Some of the chemicals are repacked at the site.

2.2 Products

The dyestuffs and chemicals stored at the site are used in the leather and textile industries: resins, flame-retardants and proofing agents.

3.0 WASTES AND BY-PRODUCTS

3.1 Solid Wastes

Packaging is frequently returned to the division by the customer. There is an increasing trend towards customers requiring that their suppliers dispose of waste on their behalf. After washing on-site, most of the packaging is disposed of to landfill off-site although some are returned to the manufacturing plant for re-filling.

3.2 Liquid Wastes

Liquid wastes constitute the major waste from the site. Approximately 20 tonnnes of liquid chemical wastes are exported off-site for incineration. Waste water is disposed of to sewer.

3.3 Gaseous Wastes

There are gaseous emissions resulting from re-packing of chemicals at the site. An air-filtration system has been installed for worker protection.

4.0 REGULATORY CONTROL

Waste water is disposed of to sewer and is subject to consents for pH, metals, particulates, fats and greases. The site receives visits from the water company or NRA at least twice a month. The division is subject to Health and Safety legislation, in particular COSHH. Transportation of chemicals is subject to The Classification, Packaging and Labelling of Dangerous Substances Regulations 1984.

5.0 POLLUTION CONTROL

The company has spent over £1.5 million upgrading safety features at the warehouse. The pollution control equipment installed at the site relates mainly to hazard prevention; the control of spillages and the prevention of fire.

- site bunding - to prevent either chemicals or contaminated water reaching the sewer
- lightning conductors
- smoke detectors and sprinklers
- compartmentalisation of fire doors
- down-flow booths in the re-packing area

6.0 COMPANY POLICY

6.1 Environmental Management

The company must adhere to the corporate environmental protection policy for the UK. The policy details a commitment to safeguarding the environment by incorporating environmental protection into the corporation's mainstream activities.

6.2 Training

The company has a formal training policy which is governed by corporate policy.

6.3 Environmental Training

Environmental issues are included in the company's training and eduction policy. Individuals will be sent on short courses to be trained in specific environmental issues. Environmental training has been incorporated into the training policy because of the benefits to the company and with a view to impending legislation. Increasingly customers expect help from the suppliers in terms of pollution problems that may result from the use of their product. Hence environmental management activities are being promoted not only on-site but "downstream." This area of environmental management is increasingly important. Personnel wil therefore be trained in order to provide environmental training to customers.

7.0 OCCUPATIONAL ANALYSIS

This section presents occupational analyses of two jobs; Health, Safety and Environmental Protection Manager; and Warehouse and Distribution Manager.

7.1. Health, Safety and Environmental Protection Manager

The Health, Safety and Environmental Protection Manager has responsiblity for environmental management at the site. Seventy per cent of the post-holder's time is related to product safety which is the most important aspect of the job. Approximately thirty per cent of the Manager's time is allocated to environmental affairs.

7.1.1 Tasks

The core environmental tasks include:

- negotiating with the water company over consent levels
- responsiblity for ensuring compliance of discharges with legislation
- responsibility for waste disposal
- providing product safety data to the customer which details both handling procedures and known hazards
- advising personnel on environmental and health and safety matters
- attendance of Health and Safety and Environment meetings.

7.1.2 Skills and Competences

The skills and competences required in order to carry out these tasks are:

- a degree in chemistry or physics
- knowledge of Health and Safety legislation relating to chemicals
- knowledge of legislation relating to the transportation of chemicals
- knowledge of environmental impacts of chemicals
- knowledge of waste disposal legislation
- good knowledge of chemicals (Red List)
- knowledge of consents
- report writing/presentation skills
- man-management skills.

7.1.3 Training

The post-holder is required to have a degree in chemistry or physics and ten years industrial experience. The post-holder is likely to have had previous laboratory experience. The post-holder will attend courses and seminars run by the Chemical Industries Association and other bodies.

7.2 Warehouse and Distribution Manager

The Warehouse and Distribution Manager is responsible for supervising the site and is responsible for hazard control.

7.2.1 Tasks

The core environmental tasks include:

- responsible for the prevention and control of spillages;
- responsible for ensuring product segregation;
- training staff in routine procedures and incident training.
- testing systems to ensure correct functioning.

7.2.2 Skills and Competences

The skills and competences required to undertake these tasks include

- working experience in the industry
- a high level of man-management skills
- knowledge of the hazardous characteristics of chemicals
- knowledge of legislation governing Health and Safety and the transportation of chemicals

7.2.3 Training

The post-holder is not required to hold any formal qualifications. Rather, work experience and experience of the issues relating to the transport of chemicals is required. Man- management skills are required at a high level.

8.0 FUTURE

The company intends to increase the provision of environmental training particularly for senior staff in the area of water pollution. The company expects the main method of training to be in-house training and the use of short courses. The company also intends to use informal method of training such as films and leaflets to increase the level of general awareness. The company considers the legal aspects of environmental management to be the most important. Regarding customer services, this is an area in which the company is expected to have an increasingly active training role. The company will train personnel in environmental issues relating to the environmental impacts of the use of a product in order to provide advice and technical assistance to the customer.

9.0 SUMMARY AND CONCLUSIONS

Case Study C4 presents a chemicals which is a subsidiary of a large multinational chemical corporation. The company does not carry out manufacturing but functions as a Distribution site, providing warehouse facilities for the storage and re-packing of chemicals.

The company is pro-active in its environmental management activities. The company has an environmental manangement policy and has also incorporated environmental training into its training and education policy. The company perceives improved environmental management as being of benefit to the company. The company's environmental management activities include providing advice to customers on the environmental impacts of their products. This "downstream" aspect of the company's activites is expected to generate environmental training requirements in the company so that they develop the expertise to provide training to customers. There is no perceived requirement for environmental management functions in the company to be carried out by environmental specialists but rather by personnel with traditional science backgrounds who have acquired post-entry environmental knowledge.

CASE STUDY M1

Case Study M1 presents a medium-sized aluminium foundry in the West Midlands. The company employs 500 employees and has a turn-over of £20 million. The company is currently a subsidiary of a large European manufacturing company.

A variety of aluminium alloys are purchased, melted, cast and subjected to a variety of finishing and surface treatment processes before being dispatched by road to customers. The company produces approximately 20 tonnes of aluminium components per day for the automotive, aerospace and defence industries.

Manufacturing produces large quantities of waste: contaminated sand which is sold to a contractor; aluminium swarf; liquid treatment chemical wastes; and amine and metal contaminated air. There are no consents on waste water discharged to sewer.

The company has not undertaken specific pollution control measures. It intends to phase out the use of CFCs and is currently investigating means by which to avoid using methanol as a surface treatment chemical in consideration of worker safety.The main factors contributing to the limited level of environmental management at the company were cited as being: the lack of regulatory control; the lack of internal or external financial support; lack of knowledge of available education and training; lack of customer demand for the company to incorporate environmental objectives into its activities; and the lack of perceived financial or "public image" benefits.

The company has not developed a formal environmental policy. Overall responsibility for the environment lies with the Board of Directors. However, environmental policy is devised by the Personnel and Training Manager who is assisted by the Personnel and Training Officer. To date, environmental policy has not been implemented, hence the role of managers, foremen, operatives and trade unions in relation to environmental management has not yet been determined.

Training is provided primarily on-the-job and supplemented by more formal means of in-house training. External consultants are used infrequently. The company's training policy incorporates Health and Safety but not the Environment.

The company intends to increase its environmental management activities as it expects to be subject to increasingly tight regulatory controls (requiring it to invest in monitoring and pollution control equipment). The company also aims to improve the level of environmental awareness amongst its staff. Formal in-house training and on-the-job training will be the main method of training for non-managerial staff and internal seminars will be the main method of management training.

The case study presents two occupational analyses: Personnnel and Training Manager ; and the Personnel and Training Officer.

Occupational Analysis

	Personnel and Training Manager	*Personnel and Training Officer*
Tasks	devising overall environmental policy ; responsibility for providing training and for identifying the training needs of staff; keeping up-to-date with environmental and Health and Safety legislation	assisting with policy development; informing managers about relevant issues and legislation; providing training seminars for managers, supervisors and shop-stewards. These tasks constitute an estimated 3% of the officer's time.
Skills and Competences	responsibility for the environment has been incorporated into personnel tasks. The current post-holder has a qualification in personnel management and is a member of the Institute of Personnel Management (IPM). Currently no scientific or technical skills are required.	Background in personnel combined with a first degreee in a scientific discipline; membership of IPM
Education and Training	The manager has attended short courses relating to Health and Safety. To date, the post-holder has not received any formal environmental training.	The officer has not received any formal training on environmental management. Self motivation and general environmental awareness has resulted in the individual actively promoting environmental management within the company.

CASE STUDY M1

1.0 THE COMPANY

Company M1 is a medium size (500 employees, £20 million turnover) aluminium foundry in the West Midlands. Although this site has been in operation for almost 90 years, it has changed ownership several times and is currently a subsidiary of a large European manufacturing company.

2.0 INDUSTRIAL PRODUCTS AND PROCESSES

2.1 Products

Approximately 20 tonnes of aluminium components are produced daily for the automotive, aerospace and defence industries.

2.2 Processes

A variety of aluminium alloys are purchased, melted, cast, subjected to a variety of finishing and surface treatment processes, before being dispatched by road to customers.

The firm operates two main processes: a die foundry and a sand foundry. In the die foundry metal moulds are used to impart the shape to the aluminium, whereas in the sand foundry, the moulds must be constructed of sand which is then set by the use of chemicals. When the cast aluminium is removed from either kind of mould the surface is modified to the required specification by a combination of welding, grinding and burnishing. The surface may then be treated either as a finishing process or to show up cracks.

3.0 WASTE AND POLLUTION

3.1 Solid Waste

Five tonnes of sand are used per day in the production process. This sand is contaminated with one or more of the following classes of treatment chemicals: isocyanates, amines, formaldehydes, phenols, ammonia, sodium silicate, and

sulphuric acid. All sand is mixed together and sold to a contractor. The company is not aware of how it was eventually used or disposed of. Empty chemical containers are generally given/sold back to the suppliers.

All swarf (metal shavings) is collected in skips and sold back to a smelting company.

3.2 Liquid Wastes

Approximately 200 litres per week of waste lubricating oil is sold for re-refining.

There are no on-site facilities for liquid waste treatment. The company is not aware of how other liquid wastes, eg, spent acids, ardrox dye (for showing up cracks) are disposed.

3.3 Gaseous Wastes

The use of molten aluminium leads to amine and metal contaminated air. This is sucked away from the shop-floor using large fans and vented to the atmosphere.

4.0 REGULATORY CONTROLS

There are no consent limits on water disposed to sewers. The only regulatory controls on the plant are those covered under health and safety legislation.

5.0 POLLUTION CONTROL METHODS

There are no specific pollution control measures (except the sand, swarf and oil recycling detailed above). However, there has recently been upgrading of the gas extraction system and preliminary investigation of the costs of fitting a scrubbing system. There is also emphasis on worker protection: dust masks, fume masks and hearing protection. The company is in the process of drawing up plans to avoid the use of methanol (as a surface treatment chemical) for reasons of worker safety.

6.0 COMPANY POLICY

6.1 Environmental Management Policy

The company has not developed a formal environmental policy.

Overall environmental policy is the responsibility of the Board of Directors but, in general, policy is devised by the Personnel and Training Manager. The Personnel and Training Officer assists with formulation and implementation. However, since little has actually been implemented, the role of departmental managers, foremen trade unions etc. has not yet been determined. The company receives some assistance from its parent organisation in the form of reports from a UK consultan on upcoming health and safety (and recently environmental) legislation.

6.2 Training Policy

The training methods most commonly used are on-the-job and other forms of in-house training. External consultants are occasionally used.

6.3 Environmental Training Policy

The Company's training policy mentions health and safety but not environment.

7.0 OCCUPATIONAL ANALYSES

Occupational analyses are presented for the Personnel and Training Manager and for her assistant, the Personnel and Training Officer. These two employees are responsible for the majority of the existing environmental management functions of the company.

7.1 Personnel and Training Manager

7.1.1 Tasks

The core tasks relating to environmental management are:

- Devising overall policy (with board liaison and approval)
- Devising or selecting training for other staff

- Awareness of existing and upcoming relevant legislation

These tasks (which also apply for health and safety) constitute an estimated 2% of the manager's time (compared with 20% for health and safety). Effectively these tasks are viewed as an addition to the health and safety responsiblities.

7.1.2 Skills and Competences

The required qualifications for this job are those relating to personnel (such as the degree and membership of the Institute of Personnel Management of the current job holder) and no specific scientific or technical skills are required.

7.1.3 Training

Although the manager has been on external courses relating to health and safety she has not had any formal environmental management training.

7.2 **Personnel and Training Officer**

7.2.1 Tasks

The core tasks relating to environmental management are:

- Assisting with policy development
- Informing management on relevant issues and legislation
- Providing training seminars for managers, supervisors and shop-stewards
- Providing training via foremen

These tasks (which, again, are similar for health and safety) constitute an estimated 3% of the officer's time (compared with 35% for health and safety). Again, since little implementation has taken place, this is basically a prediction of the tasks which will be covered by this officer.

7.2.2 Skills and Competences

Qualifications required are similar to those of the manager, but a scientific background is preferred; the current job-holder has a chemistry degree and membership of IPM.

7.2.3 Training

The Officer has been on external short courses for health and safety but not yet for environmental management. Self-motivation and general environmental awareness have led this officer to his interest in developing the company's environmental awareness and responses.

8.0 FUTURE PROSPECTS

Considerable increases in environmental management are forseen. The company expects to come under increasing regulatory control, both in terms of emissions to sewers and air. It expects to phase out its use of (a small quantity of) CFCs in the near future. However, the most significant economic and process impacts would occur if legislation required the gases arising from the foundry to be controlled, eg, by scrubbing equipment. Less significant impacts would occur if monitoring were to be required for emissions to air or sewers.

Although the company is always required to work to tight specifications from its customers, these have not yet included anything that might influence the company's environmental management. However, the company recognised that there was a high probability this might occur over the next few years.

In the short term, the priority for the company's environmental management is improving the awareness and knowledge of the managers. Necessary technical changes would generally take place after this had been achieved.

The reasons for the existing low level of environmental management (which are also potential hinderances to future implementation) are said to be:

- the lack of regulatory controls;
- the lack of internal or external financial support;

- the lack of knowledge of education and training available; lack of customer (rather than public) demand for its provision; and the lack of perceived financial or 'public image' benefits.

The company expects to provide some form of environmental training to all staff over the next two years. In-house and on-the-job training are thought to be the most appropriate methods for non-managerial staff. However, video and leaflet educational campaigns would also be considered. For management, internal seminars seem the most likely form of training.

9.0 SUMMARY AND CONCLUSIONS

The company has about 500 employees producing 20 tonnes of aluminium components per day. This involves the generation of large quantities of waste and, aluminium swarf, liquid treatment chemical wastes, and amine and metal contaminated air.

The production facilities are generally not the most up-to-date available. There appears to have been a lack of investment in both high technology and 'clean technology'. In the future, they expect there will have to be investment in monitoring and possibly pollution control equipment (scrubbing equipment for air pollution control).

Environmental management has not been a major priority for this company. Sand and swarf are given to off-site contractors, but there are no other forms of environmental management to deal with the liquid or gaseous wastes.

Developing the company's environmental management is the responsibility of the Personnel and Training Manager and the Personnel and Training Officer. Both jobs require graduates with a personnel qualification and preferably some scientific background.

There has not yet been any formal environmental training, but it is expected that environmental awareness seminars will be organised by the Personnel and Training Department for all management in the near future. It is hoped that all staff will receive some form of in-house environmental training over the next two years.

CASE STUDY M2

Case Study M2 presents a medium-sized metal manufacturing company which is a subsidiary of a large multinational corporation.

The company carries out non-ferrous smelting and refining and the main products include copper, lead and antimony. Manufacturing produces large volumes of waste. Slag is stored on-site , or where possible, sold locally for road -fill material. Liquid wastes are discharged to the river after treatment; heavy metals are precipitated out and recycled. Lead and sulphur dioxide are the two main gaseous discharges.

The company is a registered lead works and is thus subject to strict HMIP control. The NRA monitors discharge to the river. The company receives visits from HSE and the Local Authority responsible for licensing waste storage on-site. The company has invested a large amount of capital in pollution control equipment

The company is currently preparing a formal written environmental policy. The company does not have a formal education and training policy but gives high priority to training. Operative training is generally carried out on-the-job or using more formal in-house or group training. Training provision for managers includes short courses. There is no environmental training policy.

The company expects to increase its environmental activities both in terms of investment in pollution control equipment and in the provision of formal more specialised environmental training. However, there is concern on the part of the company that industry may not be able to meet the financial effects of tighter legislation and the continual downward revision of emissions targets.

The case study presents an occupational analysis of four jobs: Effluent Plant Operative; Group Manager; Environmental Scientist and Technical Manager.

Occupational Analysis

	Effluent Plant Operative	*Group Manager*	Environmental *Scientist*	Technical *Manager*
Tasks	monitoring and analysis; maintaining levels of chemicals;carrying out routine cleaning and checking tasks; checking pH levels.	overall responsibility for production; implementing health and safety legilsation; responsibility for the achievement of environmental targets; reporting on monitoring results.	sampling and monitoring; maintaining sampling equipment; liaising with regulatory bodies and operating managers; presenting monitoring figures; providing technical advice to production managers.	overall technical responsibility; liaising with environmental scientist on process development responsible for implementing company responses to changes in legislation.
Skills and Competences	knowledge of pH control, metals solubility and consents levels; a background knowledge in environmental issues is required.	knowledge of metallurgy, environmetnal legislation, ability to analyse and interpret figures; diplomacy skills	strong background in analytical chemistry; knowledge of; legislation; consents,pollution control,technology, statistics; man-management skills	Knowledge of the operation of the plant, detailed knowledge of environmental legislation; knowledge of pollution control technology;man mangement, report writing and negotiating skills.
Training	No formal qualifications required. Post entry training is provided primarily on-the-job although some formal in-house training is provided	Degree in chemistry or metallurgy. No formal environmental qualifications are required.	Degree in chemistry and five years experience or an employee who has acquired sufficient in-house experience; membership of the Royal Society of Chemistry.	Degree in metallurgy, physics or chemical engineering and ten years experience is required. The post-holder will attend seminars and short courses, particularly in relation to legislation.

CASE STUDY M2

1.0 THE COMPANY

Case Study M2 presents a medium-sized metal manufacturing company which is a subsidiary of of a large multinational corporation. Metal manufacture has been carried out at the site since 1937, although under its present ownership since 1967. The company employs 480 staff.

2.0 INDUSTRIAL PROCESSES AND PRODUCTS

The company carries out non-ferrous smelting and refining. The company buys a range of raw materials and extracts primarily tin, but also a number of other non -ferrous products.

A range of non-ferrous metals are produced to varying degrees of purity; tin, lead, copper, silver, gold, platinum, nickel, antimony.

Some of the metals are refined to a high purity finished ingot for sale to end-users. This is true of tin, copper and lead. The other metals are refined to a semi-finished product and are then sold to another processor who will extract impurities before sale for end-use.

3.0 WASTES AND POLLUTION

3.1 Solid Wastes

The main component of solid waste is the slag from the fuming furnace. It used to be disposed of to a quarry but the company now has a license to store it on site. The company produces 60-70 000 tonnes of slag per annum. Where possible, the slag is sold for road-fill material. However, it is only economical to sell it for this purpose locally, as the costs of transporting it any distance (due to its weight) is prohibitive. Nickel sulphate and cadmium precipitate are produced as by-products and sold for metal extraction overseas.

3.2 Liquid Wastes

Liquid wastes are discharged to the river after passing through on-site effluent treatment plants which precipitate the heavy metals. These solids are collected and recycled within the system. There are two outlets; one which discharges all liquid from the plant gas cleaning system ie from the scrubbers and the other which discharges all surface water. The arsenic bearing waste stream is discharged to the river on a tidal clock - two hours every twelve hours.

3.3 Gaseous Wastes

All plants feed into one main chimney except the Lurgi plant which has its own stack. Lead is the dominant metal in the gaseous discharge. The other major gaseous emission is sulphur dioxide. The company samples continuously from the stack and also monitors the effect of gaseous emissions on the locality, using dust deposit gauges and high volume air samplers.

4.0 REGULATORY CONTROL

The company is a registered lead works and is thus subject to HMIP control The company samples its outlets to the river continuously and the NRA carries out weekly sampling and analysis. The company is subject to Local Authority control as the latter is responsible for licensing the waste sites and is also involved in off-site monitoring for sulphur dioxide. The company receives visits form HSE which vary according to the level of dust recordings. Health and Safety is strictly controlled at the plant. Employees joining the company are given talks on the potential health hazards of exposure to lead, cadmium and arsenic.

5.0 POLLUTION CONTROL

The company has invested in a wide range of pollution control equipment;

1) sinter plant - supersonic chamber for exhaust gas

2) blast furnace - gas cleaning plant
grit arrester
spray tower

3) fuming furnace - spray tower
bag-house

4) lurgi - bag-house

In addition there is in-plant hygiene equipment and a range of monitoring equipment.

6.0 COMPANY POLICY

6.1 Environmental Management

The Group has produced a document detailing its commitment to environmental good practice. The individual company is in the process of preparing its own written environmental policy. Regarding environmental management activities, the company carries out extensive monitoring activities on-site and off-site. The company has three full-time positions allocated to environmental monitoring.

6.2 Training

The company does not have an environmental education and training policy. However the company places a high priority on training. Responsibility for identifying training requirements lies with the Department managers. For example, the Safety Manager may identify a requirement for a site-wide training programme. Training is primarily provided on-the-job or using in-house formal training. Where there is a requirement for a large number of employees to be trained eg, operatives requiring training on a new piece of equipment, then either the suppliers of the equipment or external trainers will be used in order to train in-house personnel to be trainers. The method of training provision is dependent primarily on the number requiring training. Management training is generally more selective involving a small number of people hence managers may be sent on short course run by the Group or by universities or trade associations.

6.3 Environmental Training

There is no formal environmental training provision. However staff are trained on environmental aspects of their job as appropriate. The company uses courses run by Loughborough University and the Centre for Professional Advancement which is based in Amsterdam. The latter specialises in highly technical courses eg, gas cleaning plant.

7.0 OCCUPATIONAL ANALYSIS

Overall responsibility for the environment at the site lies with the Managing Director. However the structure of the company is such that a number of people have responsibility for achieving environmental targets. There are two Group Managers at the site; one is responsible for smelting, the other for refining. The group manager have responsibility for achieving their respective targets. However, within these divisions responsibility is devolved to supervisor and operative level to varying degrees.

This section presents occupational analyses of four jobs : effluent plant operative; group manager; environmental scientist, and technical director.

7.1 Effluent Plant Operative

All of the effluent operative's time is allocated to environmental management tasks. The operative reports to the effluent plant supervisor. The tasks within the job have changed both in terms of the plant which the operative must operate eg, there are now filtering facilities in the plant rather than solid drying bed, and in terms of the amount of analysis and monitoring that must be undertaken. The job has changed, therefore, from being a relatively primitive operation to one involving more sophisticated plant which has been installed following the introduction of tighter controls and the requirement for improved environmental performance.

7.1.1 Tasks

The operative must carry out the tasks according to the information contained in the plant operating instructions. The core environmental tasks include:

- carrying out monitoring and analysis
- ensuring that there is enough chemical for lime dosing
- checking that the gully in which the pH probe is situated is clean
- responsibility for adding floculating agent to encourage settling of suspended solvents
- operating the transportable pumps to pump the solids
- ensuring that the flow channel from the treatment operation to the settling pit is clear
- ensuring that the settling pit is pumped out on a daily basis
- checking that pH recordings are correct
- responding to any alarms that may occur

7.1.2 Skills and Competences

The skills and competences required to carry out the tasks are:

- knowledge of pH control
- knowledge of metals solubility and pH ie attention to what substances, (and at what concentrations) are being disposed of,
- awareness of the importance of pH control
- knowledge of consent levels
- background to environmental issues to give some insight into the importance of the variables of control.

7.1.3 Training

No pre-entry training is required. Training is provided primarily on the job. However a number of courses are run in-house particularly concentrating on the importance of pH control. An operative will understudy an experienced operative for 6 - 8 weeks.

7.2 Group Manager

The Group Manager is responsible for safety and production targets. The Technical Director has responsibility for auditing these performances. The Group Manager reports to the Technical Director. Approximately fifty per cent of the Group Manager's time is allocated to environmental management tasks. The Group Manager's tasks have changed to the extent that Health and Safety legislation now demands increased biological monitoring and employees have to be tested for lead and cadmium. Increased environmental awareness has demanded increased volumes of monitoring and increased analysis of results. Managers are also increasingly aware of the environmental impact of their processes.

7.2.1 Tasks

- responsibility for total production - this includes the choice of raw materials going in to the plant and the quantity and quality of out-going product
- responsibility for staff health and safety, discipline and personal requirements
- responsibility for the standard to which the plant is being run
- liaising with the public
- responsibility for investigating production anomalies. The Group Manager is responsible for achieving environmental targets
- liaising with customers
- reporting at weekly meetings to discuss incidences where consents were exceeded
- reporting at six monthly Health and Safety committee meetings where all in-plant monitoring results are discussed. Explanations are required in cases where figures are above the statutory requirements.
- interpreting monitoring results and undertaking sampling and monitoring tasks

7.2.2 Skills and Competences

The skills and competences required to carry out these tasks are:

- knowledge of metallurgy plant
- good understanding of environmental legislation

- awareness of the constraints on production and meeting environmental objectives.
- ability to analyse and interpret figures and to identify the influencing factors
- a disciplined, logical approach
- diplomacy skills (needs to display concern and competence)

7.2.3 Training

The post-holder is required to have a science degree in chemistry or metallurgy and five years industrial experience. Regarding the environment, the Group Manager is required to have an increasing awareness of the environmental impact of the production processes. However, the post-holder is not required to have any formal environmental training. The company is very aware of the consequences of failing to meet consents and is therefore very conscious of its environmental requirements.

7.3 Environment Scientist

All of the Environmental Scientist's time is allocated to environmental management tasks. The environmental scientist reports to the Technical Director. There have been three specific changes resulting from increased environmental legislation;

1) change in the methods of analysis due to the maximum allowable concentrations being constantly revised downwards. This means that the analysis needs to meet lower limits of detection
2) industry is required to analyse new substances
3) increased level of sampling.

7.3.1 Tasks

The core environmental tasks include:

- carrying out sampling and monitoring
- checking that the sampling equipment is functioning properly and ensuring that it is properly maintained

- recording sampling results
- producing the monthly summaries of all the figures
- liaising with operating managers over undesirable trends
- liaising with the regulatory bodies-NRA HMIP
- presenting in-house monitoring results to external bodies
- providing advice to group managers on trends and recommending changes and actions where necessary,
- liaising with the analytical laboratory to devise improvements in analytical techniques
- attending annual meetings as with the local authority.

7.3.2 Skills and Competences

The skills and competences required to carry out these tasks include:

- a degree in chemistry and five years experience
- a good knowledge of analytical chemistry
- a good knowledge of environmental legislation
- detailed knowledge of consents
- knowledge of pollution control technology
- good understanding of a broad range of analytical techniques
- comprehensive understanding of chemical engineering processes
- a highly developed sense of representing the company
- strong inter- personal skills
- man-management skills
- report writing skills
- knowledge of statistics
- presentation skills - ability to present his subject to a wide range of people
- awareness of developments in monitoring equipment.

7.3.3 Training

The post-holder is required to be a member of the Royal Society for Chemists. The post-holder will generally have at least five years experience if the candidate is a highly qualified graduate recruited from outside the company. Otherwise it may be someone who has been trained on-the-job working in the analytical laboratory and has understudied the post-holder for a period of time.

7.4 Technical Director

Eighty per cent of the Technical Director's time is allocated to environmental management tasks; preparation of documentation, responses to EEC legislation, looking at daily figures from the monitoring operations, discussions with group managers regarding environmental targets and etc. There is now a requirement for the company to produce documentation supporting applications for licencing. The Technical Director reports to the Managing Director. The Technical Director has access to Group Resources which is particularly helpful in keeping up with legislation.

7.4.1 Tasks

The core environmental tasks include;

- Overall responsibility for all technical aspects on-site (both the chief analyst at the laboratory and the environmental scientist report to the technical director).
- liaising with the environmental scientist on process development
- Responsibility for implementing company responses to changes in legislation

7.4.2 Skills and Competences

The Skills and Competences required to carry out these tasks are;

- a degree in metallurgy, chemical engineering or physics
- a very detailed understanding of the operation of the plant;
- report and letter writing skills
- competent negotiating skills
- strong interpersonal skills
- man-management skills
- interpretation skills
- knowledge of environmental legislation
- financial management skills
- awareness of the issues behind the legislation
- Awareness of process development via the technical and financial constraints

There have been a number of new tasks incorporated into the job as a result of increased environmental awareness. The first has been the implementation of radioactivity monitoring which has demanded the development of a monitoring system and a recovery system. There has also been a change in the economic management of the firm. Whereas the commercial side was once concerned simply with the economics of buying the raw material, they are now concerned with the environmental ramifications. Hence the technical and commercial departments are now aware of each other's problems and increasingly work together.

7.4.3 Training

The post-holder is required to have a degree either in metallurgy, chemical engineering or physics. The post-holder is expected to have at least 10 years experience in the field. The post-holder is expected to have a high level of expertise over a range of technical issues. The post holder will attend short courses and seminars, particularly in relation to legislation.

8.0 FUTURE

The company expects to increase its environmental management activities, both in terms of investment in pollution control equipment and in formal more specialised training. However there is great concern on the part of the company over the financial demands that increasingly tighter controls and the continuous downward revision of emissions targets are making on industry. For example, if legislation requires the installation of particular pollution control plant such as flue gas desulphurisation then this might have serious economic impacts on the company. There is also concern over the fact that the regulatory bodies are increasingly playing less of an advisory role and more of a policing role. The company expressed the view that there is need for diffusion of information between companies to facilitate the adoption of best available technologies.

9.0 SUMMARY AND CONCLUSIONS

The case study presents a medium-sized metal manufacturing company which is a subsidiary of a large multi-national corporation.

The company carries out non-ferrous smelting and refining and the main products include copper, lead and antimony.

Manufacturing produces large volumes of waste. Slag is stored on site or, where possible, sold locally for road fill material. Liquid wastes are discharged to the river after treatment whereby the heavy metals are precipitated out and recycled. Lead and Sulphur Dioxide are the two main gaseous discharges.

The company is a registered lead works and is thus subject to strict HMIP control. In addition the NRA monitors discharge to the river. The company also receives visits from HSE and from the Local Authority responsible for licensing waste storage on-site. The company has invested a large amount of capital in pollution control equipment.

The company is in the process of preparing a formal written environmental policy. The company does not have a formal education and training policy but none-the-less gives a high priority to training. Operative training is generally carried out on-the-job or using more-formal in-house or group training. Management may be sent on short courses. There is no policy for environmental training. However training is provided as and when required. The company expressed a need for specific highly technical short courses and for there to be an advisory/information exchange forum in order that companies may benefit from the experience of others.

The occupational analysis detailed four jobs: effluent plant operative group manager; environmental scientist and; technical director.

The effluent plant operative's core environmental tasks are undertaking analysis and monitoring and ensuring that the effluent plant is functioning and maintained. The tasks within the job have changed, both in terms of the type of plant, (the plant has changed from being manually operated to microprocessor controlled), and the volume of analysis and monitoring that must be undertaken. In terms of the impact on skills' requirements, training on new plant is carried out by the suppliers of the equipment or by external trainers.

The group manager has responsibility for all aspects of production including environmental targets. He is responsible for presenting environmental reports at weekly meetings. Increasing amounts of the post-holder's time is allocated to monitoring and analysing tasks. The group manager must be increasingly aware of the environmental impacts of the manufacturing process.

The environmental scientist is responsible for providing monthly summaries of monitoring results and for liaising with the regulatory bodies. The post-holder is required to be a chemist with an understanding of environmental issues.

The Technical Director is required to have a degree in metallurgy, chemical engineering or physics. An increasing amount of the post-holder's time is allocated to the preparation of documentation in response to EC and UK legislation. The post-holder is required to have a strong understanding of environmental issues although no formal environmental background. Increasingly the Technical Director is liaising with other departments in order that the company has a co-ordinated approach to achieving environmental targets.

CASE STUDY M3

Case Study M3 presents a large metal manufacturing company which is part of a Group operating in the UK.

Manufacturing produces large volumes of solid waste , the majority of which is disposed of to landfill on-site. Ammonia vapour is incinerated on-site and slag from one of the industrial processes is sold for re-use. Aqueous wastes are discharged to the estuary.

The Group has produced an environmental brochure detailing the measures which have been undertaken to safeguard against environmental damage. At company level the impetus for improved environmental awareness is driven by senior management. The company has recently taken steps to increase environmental awareness and good practice at operative level. For example, a bonus scheme has been implemented whereby incentive payments are awarded for the achievement of environmental targets.

The company has a formal education and training policy which is determined by Group policy. A system of Total Quality Performance has been implemented which contains a commitment to training and overall improvement in standards. The company has allocated a large budget to training and actively encourages staff at all levels to undertake some form of post-entry training.

There is no formal environmental training provided. However a series of modules have been produced on the environment and increasingly environmental aspects are being incorporated into Health and Safety and Management courses.

The company expects to increase its provision of training on general environmental awareness. Increasingly environmental issues will be incorporated into supervisory, professional and managerial courses run in-house. The company is of the view that the management structure is the best mechanism for promoting environmental awareness.

The case study presents an occupational analysis of three jobs: Tar and liquor attendant, Tips Contoller; and Environmental Services Engineer.

Occupational Analysis

	Tar and Liquor Attendant	Tips Controller	Environmental Services Engineer
Tasks	maintaining and operating the system; operating recovery and separating equipment; operating the stills; supervising incineration of ammonia;monitoring pH nitrates and temperature.	supervising operatives; hiring and deploying machinery; recording types and volumes of wastes; liaising with external bodies involved with waste disposal; liasing with plant managers (ie, waste producers)	devising capital development projects; liaising with regulatory bodies and the public; monitoring; providing technical advice to plant managers; carrying out design work on plant to improve environmental performance
Skills and Competences	a thorough knowledge of process, plant equipment and control operations; understanding of the chemical processes; knowledge of the parameters within which the plant must operate.	knowledge of waste arisings; knowledge of manufacturing processes; limited engineering knowledge; operation of mobile tools; knowledge of waste disposal legislation.	competent engineer; comprehensive knowledge of the manufacturing processes; knowledge of environmental legislation; knowledge of pollution control techniques
Education and Training	No formal qualifications are required; post-entry training includes twelve weeks on-the -job training on by-product operations and the post-holder may take a City and Guilds in coal carbonising and by-products.	No formal qualfications are required; work experience including specific knowledge of mobile equipment and experience of waste disposal. Post-entry training is provided primarily on-the-job; professional journals are a useful source of information: short courses might be used if appropriate.	Chemical engineering degree or an appropriate level of experience in the industry. Post- entry training will be provided formally in-house and using external short courses.

CASE STUDY M3

1.0 THE COMPANY

Case study M3 presents a large metal manufacturing company which is part of a group based in the United Kingdom. Metal manufacture has been carried out at the site for more than one hundred years.

2.0 INDUSTRIAL PROCESSES AND PRODUCTS

Metal products are produced mainly for the construction industry.

3.0 WASTES AND POLLUTION

The majority of waste arising are disposed of to land-fill on site (approximately 600,000 tonnes p.a. of solid and liquid waste and 20,000 tonnes p.a. of special wastes). Ammonia vapour is incinerated on-site. Slag from one of the industrial processes is sold for re-use.

3.1 Solid Wastes

The solid wastes produced by the manufacturing process include:

- inert slag;
- construction wastes.

3.2 Liquid Wastes

The liquid wastes produced by the manufacturing process include:

- slurries which are disposed of to landfill on site;
- aqueous wastes which are discharged to the estuary.

3.3 Gaseous Wastes

There are four categories of gaseous wastes:

- products of combustion
- oxides of nitrogen

- oxides of nitrogen
- oxides of sulphate
- particulate matter.

3.4 Noise

Noise presents a serious problem both in terms of the internal working environment and the external environment.

3.5 Soil

Soil assessments are only carried out where a plant has been closed down or where land is being re-claimed.

4.0 REGULATORY CONTROL

The site is closely monitored closely by the NRA and the County Council which is the licensing body for the landfill sites. Inspectors from the County Council visit the landfill sites every week. Regarding aqueous wastes, the company has a license for six outfalls to the estuary of which one waste stream is treated at a biotreatment plant. The NRA is responsible for monitoring the waste streams and for setting the consent levels.

5.0 POLLUTION CONTROL METHODS

A wide range of pollution control equipment has been installed at the plant. The main types include:

- cyclones
- bag filters
- electro-static precipitators
- wet scrubbers

The company has committed itself to a large capital expenditure on pollution control equipment.

To date, the main emphasis of the company's environmental management has been monitoring of emissions to atmosphere. An extensive air monitoring system has been implemented which comprises four stages:

- visual techniques
- manual monitoring ie measure the time and weight to assess the concentration of emissions
- continuous monitoring
- hygiene monitoring- using Local Authority dust deposit gauges.

Regarding waste disposal the company has a number of licensed tips on-site including licenses for special wastes. In view of impending legislation on waste disposal, the company is now considerably stricter about which wastes are disposed of to the landfill sites.

Regarding treatment of aqueous water there is one effluent plant operating at the site which treats one of the six waste streams.

6.0 COMPANY POLICIES

6.1 Environmental Management

The Group has produced a brochure detailing the measures which have been undertaken to safe-guard against environmental damage. The brochure was produced in response to increasing pressure from the public and from share-holders for the company to demonstrate environmental awareness. At company level the impetus for improved environmental management is driven from the top. Workers may have an environmental awareness but there is no evidence that this is translated into working practices. Responsibility for the environment lies with each plant manager. However, there is an environmental department on site which provides advice and technical support on environmental issues and is responsible for liaising with the regulatory bodies. The company has recently taken steps to increase environmental awareness and good practice at operative/shop floor level. One example of this is the implementation of bonus schemes whereby incentive payments are awarded for the achievement of emission targets.

6.2 Training

The company has a formal education and training policy which is determined by Group policy. A system of Total Quality Performance has also been implemented which contains a commitment to training and achievement of high standards. The company has designated a large budget to training. Recently two-thirds of its training department amalgamated with the training department of another large

company to form a separate training company. The amalgamation was the result of recognising common training requirements of the two companies. Responsibility for training lies with line-management which has the responsibility for ensuring that staff receive required and appropriate training. However, line-management will liaise with the training department to assess training needs. The training strategy is concerned with employee self-development. Manual grades, for example, are encouraged to take a City and Guilds Certificate in process engineering. As part of the company's drive towards "team workers" and in line with the improved quality objective, operatives are encouraged to take courses, not simply in the operation of their own particular piece of plant, but also in the operation of processes down-stream and up-stream. This approach should enhance safety at the site by developing an overall understanding of production. Similarily, there is a drive towards eliminating the demarkations that exist between the various craftsmen towards establishing two main craft g ups; mechanical and electrical engineering. Regarding middle manager level, there is an initiative to encourage engineers to obtain chartered status. The company is running a series of professional engineering courses and management and supervisory courses. The company also provides graduate training programmes and student opportunities. The company, therefore, actively encourages staff to undertake training which is connected to their job. The company also has an open learning centre which personnel are encouraged to make use of. The company will pay all fees and will pay a daily allowance to personnel who attend training on their days off. The company has developed strong links with local colleges. Health and Safety represents a large element of the training programme reflecting the priority given to safe-working procedure. In this respect the increasing number of contract staff working at the site is an issue of concern as the company has only limited control over their level of training. The main method of training provision is in-house using company or Group expertise. However short courses are used as and when appropriate.

6.3 Environmental Training

There is no formal Environmental training provided. Specific initatives have been undertaken; eg, personnel within the Environmental Division have been asked to write a series of modules corresponding to their particular area of expertise. Seminars have also been carried out and increasingly environmental aspects are being incorporated into Health and Safety issues. However, to date, very little formal provision exists.

7.0 OCCUPATIONAL ANALYSIS

This section presents occupational analyses of three jobs involving responsibility for environmental management:

- Tar and liquor attendant;
- Tips Controller;
- Environmental Services Engineer.

7.1 Tar and Liquor Attendant

Thirty per cent of the operative's time is allocated to environmental management tasks. The operative is responsible for monitoring the distillation of liquor which releases the ammonia and for collecting the ammonia and supervising its incineration. The residual liquor provides the main feed stock to the biotreatment plant. As a result of increased environmental management the amount of the operative's time which is allocated to monitoring tasks has increased particularly following the introduction of targets for both the level of suspended solids in waste streams and emission levels from particular plant.

7.1.1 Tasks

The core environmental tasks include:

- responsibility for the ammonia and tar that comes out of the system
- responsibility for the maintenance and operation of the system
- operation of micro-processor controlled plant;
- operation of the recovery and separation equipment;
- monitoring the operation of the stills that recover the ammonia from the liquor

- supervising the incineration operation of the ammonia recovery
- monitoring of pH, nitrates and temperature
- monitoring the settling ponds and sludge thickness.

7.1.2 Skills and Competences

The skills and competences required to carry out these tasks include:

- a thorough knowledge of the process, plant, equipment and control operations
- a knowledge of hazardous chemicals
- a limited knowledge of the chemical processes taking place in the plant
- a good working knowledge of safe working area
- a knowledge of the parameters within which the plant must operate.

The operative will also be aware of the occupational hygiene aspects of his job. As a consequence of his exposure to potentially harmful substances the post-holder will be regularly screened. However, the post-holder is unlikely to be aware of the potential environmental impacts of his work activities.

7.1.3 Training

The liquor and tar attendant is required to have had a twelve week training on by-products operation. He is likely to have undertaken a City and Guilds course in coal carbonising and by-product recovery. This will be under taken on a day-release basis whereby the employee is released from work to attend a local college and is paid by the company to attend the course on his days off.

7.2 **Tips Controller**

The majority of waste is diposed of to landfill on-site. The tips controller has overall responsibility for waste disposal on-site. All of the tip controller's time is allocated to environmental management tasks. The tips controller reports to the Section Manager although overall responsibility for waste disposal lies with the Environmental Services Engineer. The Tips Controller's tasks have changed in that firstly, waste disposal is subject to increasingly strict

regulation and secondly, due to impending legislation, the company is aware of the need to conserve capacity for land-fill on-site and consequently the Tips Controller is much more selective in which wastes he accepts for disposal.

7.2.1 Tasks

The core environmental management tasks include:

- supervision of operative staff;
- hiring and deploying machinery;
- recording amounts and types of waste that are diposed of to the land-fill sites;
- planning waste disposal ie. directing wastes to particular tips as well as planning the structure of the tips;
- liaison with external bodies involved with waste disposal: contractors responsible for treating the waste which is diposed of off-site; industry which buys by-product materials and; the county council responsible for licensing and inspecting the sites.
- liaison with the plant managers ie. the waste producers and providing technical advice on waste problems.
- liaison with a variety of people ranging from inspectors at the county council to drivers

7.2.2 Skills and Competences

The skills and competences required to carry out these tasks are;

- knowledge of waste arisings
- knowledge of the manufacturing processes -an in-depth knowledge is not required but some understanding of the processes is essential
- some civil engineering knowledge is required in order to assist in the design of the landfill sites
- knowledge of the operation of large mobile equipment
- strong interpersonal skills
- knowledge of environmental legislation particularly relating to waste disposal;
- knowledge of the geography of the plant in order to determine the sources of particular waste

7.2.3 Training

No formal qualifications are required for the job. The post-holder is expected to have extensive work experience in the industry and to have specific knowledge of large mobile equipment. He is required to to have a general understanding of the processes which are undertaken at the site and and a specific knowledge of waste management issues and legislation. The main form of training is either on-the-job training or formal in-house training. However, appropriate short courses are used if available. Informal training on environmental issues is provided in the form of informal "chats" with the Environmental Services Engineer and through reference to professional journals and periodicals. The post-holder is not required to have any background in environmental affairs but it is useful if he has an interest in the area.

7.3 Environmental Services Engineer

The company has an Environmental Division which is headed up by the Environmental Services Engineer. All of the post-holder's time is allocated to environmental management tasks. The Environmental Services Engineer reports to the Manager for Energy and Maintenance Services.

An example of a new task which has been incorporated into the job, as a result of the increased importance attached to environmental management, is environmental auditing which is being carried out in conjunction with the plant managers across the fourteen major production areas. There has also been a change in the emphasis attached to a number of jobs. For example, whereas traditionally the job was mainly project related, increasingly, a large amount of time is allocated to liaising with external bodies; namely the local authorities, the regulatory bodies and the public. There is also, increasingly, an interface with the department responsible for Occupational Hygiene and the Works Doctor. The Environmental Services Engineer is required to sit on a number of committees: the noise committee; the occupational hygiene group; the hygiene group. He is therefore required to have a broad understanding of the major Health and Safety issues and was in fact involved with assessing the impact of COSHH.

Approximately forty per cent of the post holder's time is allocated to engineering activities and sixty per cent to other "miscellaneous" activities within the context of the environment.

7.3.1 Tasks

The core environmental management tasks are:

- capital development projects- this involves writing specifications for new kit and tender evaluations
- liaison with regulatory bodies and the public
- monitoring -responsible for co-ordinating monitoring equipment into the system and ensuring compliance with requirements
- liaison with the Local Authority on the Dust Detection gauges
- liaison with plant managers regarding technical advice on plant
- carrying out conceptual design work on plant to improve the environmental performance;
- liaison with Health and Safety and Occupational Hygiene

7.3.2 Skills and Competences

The skills and competences required to carry out these tasks include:

- required to be a competent engineer
- a comprehensive knowledge of the manufacturing processes
- a good knowledge of environmental legislation
- required to have a good knowledge of environmental engineering
- a good understanding of environmental issues
- a good understanding of the techniques of pollution control and pollution control equipment; waste management; and effluent control.

7.3.3 Training

Ideally the post-holder is required to hold a degree in chemical engineering. However, a candidate who did not hold a degree but was considered to have an appropriate level of expertise would be considered for the job. Post-entry training will be provided both using in-house modules and seminars and using short courses if appropriate. A great

deal of emphasis is placed on training. The post-holder will be involved in providing training on environmental issues relating to the company to staff within the department and to other divisions.

8.0 FUTURE

It is expected that the company will increase its provision of training on general environmental awareness. This general promotion is expected to be developed through informal on-the-job training, supplemented by environmental components in in-house courses. Increasingly, environmental issues will be incorporated into the supervisory, professional and managerial courses. An environmental module is likely to be included in the open learning centre. Specific environmental training will be provided to specialists usually in the form of short courses.

It is thought that the management structure represents the most effective mechanism of transmitting environmental awareness. For example, the implementation of a system of environmental auditing will increase environmental awareness, as demands are made on staff at all levels.

As a result of legislative demands, and in response to public concern, the company expects to increase its environmental management activities across all areas of production.

9.0 SUMMARY AND CONCLUSIONS

The case study presents a large metal manufacturing company which is based in the UK.

The company produces large volumes of waste, the majority of which are disposed of to landfill on-site. Aqueous wastes are discharged to an estuary. The company is closely monitored by the County Council, which is the Licensing Body for the land-fill sites, and the NRA.

The company has invested a large amount of capital in pollution control equipment and has also implemented an air monitoring system at the site.

Regarding Environmental Management Policy, the Group has produced a brochure which details the measures undertaken to protect the environment. The company adheres to the Group training policy, which places great emphasis on self-development and encourages employees to invest in education and training. There is no formal provision of environmental training although initiatives have been undertaken by the company in order to promote environmental awareness. The first is the payment of bonuses to operatives for the achievement of emission targets and the second is the writing of environmental modules in order to disseminate environmental information using in-house expertise.

Section 7 detailed occupation analyses of three job titles; operative, tips controller (supervisor level) and; environmental services engineer.

The operative does not require pre-entry qualification and receives post-entry training primarily on-the-job although he/she will be encouraged to take City and Guilds which usually involves study by day-release. Whilst the post-holder is trained to understand the importance of working within certain parameters and is aware of the consequences of exceeding emission targets or consents, the operative is unlikely to have a more general environmental awareness.

The supervisor in this case, had specific responsibility for waste disposal at the site. The post-holder is expected to have experience in the field and will receive post-entry training using informal on-the-job and formal in-house training and short courses on waste management. The supervisor is likely to have a general background in environmental issues and a particular knowledge of waste disposal legislation.

The Environmental Services Engineer is in charge of the environmental division in the company which provides technical assistance to the plant manager on pollution control. The Environmental Services Engineer is required to have a degree in chemical engineering (or a closely related discipline) or an appropriate level of experience acquired in the field. The post-holder is unlikely to be a environmental scientist but rather is expected to be a competent engineer with an additional understanding of the environment. There is, therefore, a requirement for short courses which are specific enough to respond to the type of requirements which industry demands.

In conclusion, the company is expecting to increase its environmental management activities, both through expenditure on pollution control equipment and through the promotion of environmental awareness in the company which will be filtered down through the management structure.

In the case of Health and Safety, where as the initial measures were implemented through the management system, the workforce have subsequently taken on the responsibility and are now intolerant of sub-standard operations. It is expected therefore, that environmental management will go through the same evolutionary cycle. There needs to be changes in the culture of the company whereby the environment becomes an integral part of the working environment in a similar way to Health and Safety.

CASE STUDY M4

Case Study M4 presents a medium-sized independent metal working company. The company employs 98 employees and has an annual turn-over of £3.5 million.

The company carries out a metal pressing and finishing operation. The main products are press parts for the motor industry eg. switch parts, buildup-units and end-caps to fuses.

The main wastes from processing include effluent sludge; scrap metal (which is sold to merchants); waste solvents and waste oils. Aqueous waste is discharged to sewer and is subject to a series of consents.

The company has not produced a formal written environmental policy. Good environmental practice is being promoted by individuals within the company rather than being determined by company policy. As a result of increased environmental awareness, the company has implemented changes in its processing methods and particularly, in the types of chemicals used. This has resulted in a substantial reduction in the volumes of waste produced with significant savings in waste disposal costs.

The company does not have a formal training policy. The main method of training provision is on-the-job. There is no provision of environmental training by the company. Overall responsibility for environmental issues at the site lies with the Works Manager. The main constraint on the up-take of environmental training and environmental good practice is economic. Senior management does not consider investment in pollution control equipment and environmental training to be a priority. A second constraint is the lack of information available to SMEs regarding all aspects of environmental management; legislation, training, pollution control technologies and clean technologies.

The company expects to continue its informal environmental management practices. The company will comply with legislation but believes that there is a need for financial incentives in order to encourage a more pro-active approach to environmental mangement.

The case study presents an occupational analysis of three jobs: Supervisor, Charge hand and Operative. Only the supervisor's jobs includes core environmental tasks.

Occupational Analysis

	Operative	*Charge Hand*	*Supervisor*
Tasks	operating all types of plant ; this involves following written instructions; taking temperature readings, recording information; following procedures for cleaning plant which involves collecting harmful solvents.	supervising operative staff; operating all types of equipment; monitoring and maintaining the level of volatile chemicals; recording information;	ensuring that chemicals comply with legislation and have no adverse environmental effects; monitoring the effluent treatment plant; providing training to operatives; liaising with Regulatory bodies; implementing Health and Safety legislation.
Skills and Competences	knowledge of the operation of all types of plant; awareness of the health and safey aspects of the chemicals; ability to follow instructions.	detailed knowledge of the operation of the plant; supervisory skills; knolwedge of legislation, consents and Health and Safety.	in-depth knowledge of the manufacturing processes; knowledge of Health and Safety legislation; knowledge of legislation governing chemicals; knowledge of consents; man-management skills
Education and Training	No pre-entry qualifications are required . Post entry training is provided on-the-job. There is no provision of environmental training.	No formal qualifications are required. Three to five years experience in the industry is required. All training is provided on-the-job.	Five to ten years experience in the industry is required or a chemistry degree and some industrial experience. Training is provided primarily on the job. The post-holder may attend conferences and seminars on environmental issues.

CASE STUDY M4

1.0 COMPANY

Case Study M4 presents a medium-sized independent metal working (pressing and plating) company. The company has been operating at the site, under the same ownership, for 63 years. The company employs 98 employees and has an annual turn over of £3.5 million.

2.0 INDUSTRIAL PROCESSES AND PRODUCTS

2.1 Processes

The company carries out a pressing and finishing operation. The raw materials used in manufacture include;

- 259 tonnes of brass pa
- 286 tonnes of aluminium pa
- 81 tonnes of copper pa
- 33 tonnes of aluminium pa
- 10 tonnes of stainless steel pa.

Processing involves a flat strip of metal, either ferrous, non-ferrous, aluminium or brass mix, lubricated with oil, being subject to either progressive tooling which produces a finished product or to separate operation tooling. The volume and complexity of the component determines the method of production that is used. The work is then subject to a metal cleaning operation to remove the oil. This can be undertaken by three methods :

1) solvents
2) hot electro-cleaning (work is placed in a bath of cleaning fluid and an electric charge is passed)
3) barrel clean (work is placed in a barrel with a cleaning agent and is subject to agitation)

The finishing processes carried out include: tin plating for the fuse industry; nickel plating and; silver flash. Heat processing is also carried out. This is a normalising function for stress.

2.2 Products

The products are fifty per cent ferrous, fifty per cent non-ferrous. The main products include press parts for the motor industry eg, switch parts, build up units and end-caps to fuses. The company has an order to produce 400 million end caps per annum.

3.0 WASTES AND BY-PRODUCTS

The main solid waste produced is effluent sludge which is stored in holding tanks which have a capacity of 6000 gallons. These are emptied once every two years. Scrap metal is sold to scrap merchants; approximately 120 tonnes per annum.

3.2 Liquid Wastes

The main liquid wastes are waste solvents and waste oils. The company produces two drums of solvents every month. These are taken by suppliers and refined for re-use. Aqueous waste is treated at the waste-water-treatment-unit, which is designed to neutralise acids and alkalis, and then disposed of to sewer.

3.3 Gaseous Wastes

The company is currently undertaking a monitoring survey in order to characterise its gaseous emissions.

4.0 REGULATORY CONTROL

Discharge of aqueous wastes to the sewer are subject to consents :

suspended solids	400 mg per litre
chemical oxygen demand (COD)	30 mg per litre
total metals	30 mg per litre
cyanide	10 mg per litre
pH	6-12

The NRA visits the company on a monthly basis. However, generally, the company does not receive regular visits from other regulatory bodies. The company is very conscious of Health and Safety as it uses a number of potentially hazardous chemicals in the finishing process.

5.0 POLLUTION CONTROL

The pollution control equipment installed at the site includes;

- bag-filters
- waste-water-treatment-unit
- electro-static filters
- extractor fans

6.0 COMPANY POLICY

6.1 Environmental Management

The company has not produced a formal written environmental policy. Overall responsibility for the environment lies with the Works Manager. Good environmental practice is being promoted by supervisors within the company rather than as a result of policy formulation by senior management. The company has changed some of the processes undertaken and the types of chemical used in order to further environmental management. For example, in the metal cleaning operation, the company is moving away from the use of solvents. The cleaning agent used in the barrel cleaning operation is biodegradable. The company has found there to be economic benefits from using safer chemicals. Firstly, because the harsh acids are expensive and secondly because of the reduction in waste associated with the use of less harsh acids. The use of safer chemicals has reduced the loss of metal with a subsequent 75% reduction in waste. As a result waste disposal costs have decreased from £40 000 to £600 over the past five years. The quality of the finish has been slightly affected, although not significantly.

6.2 Training

The company does not have a formal training policy. Training is provided primarily on-the-job. Middle and senior management infrequently attend seminars.

6.3 Environmental Training

There is no provision of environmental training. However awareness is being promoted by individuals in the company.

7.0 OCCUPATIONAL ANALYSIS

This section presents an occupational analyses of three jobs. Only a small proportion of the tasks undertaken relate to environmental management tasks.

7.1. Supervisor

The Supervisor of the Finishing Plant has responsibility for all aspects of the Finishing process. He reports to the Works Manager. It is not possible to estimate the time allocated to environmental affairs as it is an area of work which is carried out informally and within more routine tasks. The tasks in the job have changed to the extent that the supervisor is now concerned with the environmental impact of chemicals and has changed both the processes and the chemicals used at the plant in order to mitigate environmental impacts.

7.1.1 Tasks

There are two core environmental tasks carried out by the supervisor. The first is to ensure that the chemicals used in processing comply with legislation and have no adverse impacts on the environment. The supervisor is aware of the trade-offs that exist between chemicals which may be a higher risk in terms of Health and Safety and those which are damaging to the external environment. The plant has changed from using oxidising chemicals which removed metals, to a high polish finish. This has had a dramatic impact on the amounts of waste being produced. The second is the monitoring of the effluent treatment plant; checking the pH and maintaining the levels of the reagent tanks.

The core tasks include:

- overall responsibility for the through-put of production
- responsiblity for designing the finishing operation
- financial management of the section
- providing training for operative staff
- maintenance of records on the amounts of tin plating used
- monitoring, recording, ordering and testing the chemicals from suppliers- the chemicals are assessed on the basis of price, availability, nation of origin and environmental friendliness
- monitoring the pH of the effluent streams- these are recorded every 2 or 3 hours and logged
- liaison with a number of external bodies- customers and suppliers of equipment
- liaison with the regulatory bodies-namely the Water Authority
- implementing Health and Safety legislation.

7.1.2 Skills and Competences

The skills and competences required in order to carry out these tasks are:

- in depth knowledge of all the finishing operations and of the overall manufacturing process
- knowledge of Health and Safety legislation
- knowledge of legislation concerning chemicals
- good knowledge of chemicals
- knowledge of consents
- knowledge of efficiency of plant , in particular concerning the Health and Safety aspects of the plant
- man-management skills.

A significant proportion of the supervisor's time is allocated to Health and Safety matters. Many of the chemicals used in the finishing process are potentially lethal. Operatives therefore are highly supervised when dealing with particular chemicals in particular finishing processes. The supervisor is currently looking at alternative plant in order to minimise the potential health and safety risks. Regarding the type of chemicals used in the processing, suppliers are now required under COSHH to supply information both on the nature

of the chemical products and on their health and safety impacts. The supervisor will make decisions regarding the future use of chemicals on the basis of, this recently available, information.

7.1.3 Training

There are no formal qualifications required for the post. The post-holder has twenty years experience in the industry. The job requires an individual to have either 5-10 years working experience or a strong technical background ie, a chemistry degree and some working experience. The post-holder has not undertaken any formal training. Informal training is given primarily on-the-job. Regarding legislation, the main source of information is given by the suppliers, in the case of chemicals, and by the Water Authority in the case of consents on discharge. The Trade Association was cited as being a useful source of information on a wide variety of issues particularly in relation to seminars and conferences on environmental issues. Despite the fact that training is not formalised, on-the-job training is rigorous. There is a great deal of emphasis on Health and Safety.

7.2 Charge Hand

The Charge Hand reports to the Supervisor and is responsible for carrying out supervision of operative staff and for implementing Heath and Safety procedures in the supervisor's absence. He also has responsibility for providing on-the-job training to junior operative staff.

7.2.1 Tasks

The core tasks include:

- supervision of operative staff;
- operating all types of plant in the Finishing process;
- responsibility for turning the equipment off at close down;
- monitoring and maintaining the level of chemicals (because they are volatile).

7.2.2 Skills and Competences

The skills and competences required to undertake these tasks include

- working experience
- supervisory skills
- detailed knowledge of the operation of the plant
- knowledge of legislation both on Health and Safety and Chemicals

7.2.3 Training

No formal qualifications are required to undertake the responsibilities in the post. Three to five years working experience is required. Post-entry training is provided on the job.

7.3 Operative

The operative reports to the Supervisor. There are 11 processes which are in the Finishing Division. The operative is trained to operate all types of plant equipment. This section identifies the tasks of the operative for two of these processes.

7.3.1 Tasks

All work which comes into the Finishing process has a red route card which identifies the process to which the work must be subjected. The operative must be able to follow these instructions.

Hand De-greasing

The operative must distribute the work into 4-6 baskets which are lowered into a vapour zone until the temperature of the material is equivalent to the temperature of the vapour. The operative monitors the temperature using a British Standards approved thermometer. The baskets are then transferred into a solvent wash and the operative then turns the barrel in order to drain all the solvent off the baskets are left to drain.

The Hand De-greasing plant is cleaned out once a week. The operative is trained to carry out this potentially hazardous operation with due regard to Health and Safety.

Heat treatment

The material is placed into the bins, it is electro-cleaned and then dried. The operative must then follow the heat treatment instructions which are coded according to the particular material. The operative must then operate the plant. This involves; setting the temperature; setting the chart; timing the process by the chart and; recording the date, temperature and code number (ie the job description code).

7.3.2 Skills and Competences

The skills requirements of the operative staff are:

- knowledge of all types of plant and their operation
- awareness of the health hazards associated with the chemicals
- awareness of the dangers of contamination of one chemical from one process to another
- ability to follow instructions
- ability to carry out safe working procedure
- basic numeracy and literacy

7.3.3 Training

No pre-entry qualifications or training are required and no formal post entry training is provided. The operatives are trained on the job.

8.0 FUTURE

The company will continue to pursue its informal environmental management practices. The company will comply with legislation but perceives there to be a need for financial incentives in order to encourage a more pro-active approach. The main constraint on improved environmental management is the lack of information and the fact that senior management in the company does not consider capital expenditure on pollution control equipment to be a priority.

9.0 SUMMARY AND CONCLUSIONS

Case Study M4 presents a medium-sized independent metal working company. The company carries out metal pressing and finishing operations. The main products include press parts for the motor industry and end-caps to fuses.

The company has not produced a formal written environmental policy. Good environmental practice is being promoted by individuals within the company. As a result of increased environmental awareness, the company has implemented changes in its processing methods, in particular, the types of chemicals used. This has resulted in a substantial reduction in the volumes of waste produced with considerable cost savings to the company.

The company does not have a formal training policy. The main method of training is on-the-job. The case study presents occupational analyses of three jobs; supervisor, charge hand, and operative. Only the supervisor's job includes core environmental tasks. The post-holder is responsible for ensuring that the chemicals used in processing have no adverse environmental impacts. He is also responsible for monitoring the effluent treatment plant.

The main constraint on the uptake of environmental training and environmental good practice is perceived to be economic. Senior management does not consider investment in pollution control equipment to be a priority. Hence unless there are proven economic benefits or unless required by legislation, the company is unlikely to become more pro-active in this area. A second constraint is the lack of information regarding all aspects of environmental management; legislation,

training, pollution control technologies and clean technologies. There would appear to be a need for an information exchange to facilitate access to information for small and medium-sized firms.

CASE STUDY M5

Case Study M5 presents a medium-sized lead smelting company which is a subsidiary of a multi-national corporation. The company employs approximately 200 staff.

The company produces lead ingots using lead from car batteries, scrap metal and lead which is sold as a by-product from other industries. The main wastes from manufacturing include slag from the furnaces which is disposed of to landfill off-site and aqueous waste which is discharged to the river. Gaseous emissions from the stacks include lead and sulphur dioxide.The main legislation governing the activities of the company is the Control of Lead at Work Act 1980. The company is a registered Lead Works and is thus subject to HMIP control. Discharge of aqueous wastes to the river is subject to consents and is monitored by the NRA.

The company has produced a formal written Health and Safety and Environmental plan which sets out an environmental plan for 1990, detailing environmental objectives in terms of modifications to plant and specific emissions targets to be achieved. The company must also comply with the environmental policy of the Group. Increasingly resources are being allocated to R&D into new technologies both at Group and company level.

The company has a training plan which sets out the training programme for each member of staff for the current year. Due to the nature of the industry, environmental training is provided for all new recruits. Every new member of staff is given a written training brief which outlines the environmental issues that are relevant to the operations of the company. The company does not provide on-going environmental training.

The case study presents an occupational analysis of four jobs: Smelter Operative, Environmental Chemist; Technical Manager; and Human Resources Manager.

Occupational Analysis

	Smelter ***Operative***	**Environmental** ***Chemist***	**Technical** ***Manager***	***Human Reource*** **Manager**
Tasks	Operating the furnaces and refining plant (operation of valves and dampeners); driving mobile equipment; cleaning/sweeping duties.	carrying out all monitoring on-site; reporting and: liaising on results; maintaining and repairing equipment; developing analysis techniques;	keeping up-to-date with legislation; responsible for overall environmental performance of the plant; aware of technical developments;liaising with regulatory bodies	Overall responsibiity for environmental issues; devising an environmental strategy; carrying out a co-ordinating role between the subsidiary companies;
Skills and Competences	Numeracy, literacy; ability to follow instructions; understanding of the process operations;	chemical background; knolwedge of metallurgical industries;analytical chemistry, knowledge of legislation.	knowledge of legislation; knowledge of pollution control technology; engineering knowledge;report writing/presentation skills.	experience of strategic planning; knowledge of legislation; broad understanding of metallurgy; broad understanding of environmental issues
Education and Training	No formal qualifications are required . Post-entry training is provided primarily on-the-job or on-site. Environmental training is provided as part of the induction programme but there is no further environmental training.	GCSE in chemistry. Generally the post-holder would have under-studied the post for a period of time. Training is provided primarily on-the-job	Degree in chemistry, engineering or metallurgy; no formal environmental qualifications are required.	ten years industrial experience. Currently responsibility for environmental aspects has been incorporated into a Personnel function. In the future there may be a demand for an environmental specialist.

CASE STUDY M5

1.0 COMPANY

Case Study M5 presents a medium-sized secondary lead smelting company which is a subsidiary of a multi-national corporation. Lead smelting has been carried out at the site since the early 1900s. The company employs approximately 200 staff.

2.0 INDUSTRIAL PROCESSES AND PRODUCTS

2.1 Processes

The company carries out a secondary lead smelting operation. The raw materials used in processing include: lead from car batteries, lead from scrap and lead which is sold as a by-product from other industries.

2.2 Products

The company produces lead ingots of 99.97% purity.

3.0 WASTES AND BY-PRODUCTS

The main solid waste is slag from the furnaces which is diposed of to landfill off-site.

3.2 Liquid Wastes

The main liquid waste is aqueous waste. The site discharges 25-30 cubic metres of aqueous waste per hour to the river.

3.3 Gaseous Wastes

The gaseous emissions from the stacks include lead, sulphur dioxide and dust particles. Lead and dust emissions are controlled by HMIP.

4.0 REGULATORY CONTROL

The main legislation governing the activities of the company is the Control of Lead at Work Act 1980. The company is a registered Lead Works and is subject to HMIP control. The operations at the company are also subject to COSHH and regulations governing noise. Discharge of aqueous wastes to the river is subject to consents and is monitored by the NRA.

5.0 POLLUTION CONTROL

The pollution control equipment installed at the site includes;

- a new smelter with up-to-date pollution control equipment
- an effluent treatment system - designed to remove heavy metals and other pollutants.

A comprehensive monitoring system has been installed which monitors all wastes. Traditionally the company used to only sample for lead but under COSHH it is now required to sample for a range of substances. The company monitors within a two mile radius of the site.

6.0 COMPANY POLICY

6.1 Environmental Management

The company has produced a formal written Health, Safety and Environmental plan. The document contains a detailed environmental plan for 1990 which sets out environmental objectives in terms of modifications to plant as well as detailing the specific emissions' targets which are to be achieved. Overall responsibility for the environment lies with the Chief Executive although, functionally, environmental issues are dealt with by the Technical Manager.

The UK Group has also produced a formal written environmental policy with which the company must comply. This policy details a number of environmental measures to which the company is committed.

1) a formal system of monitoring and reporting
2) liaising with the public
3) continual downward revision of targets
4) research into clean technologies

The Group has undertaken major investment initiatives in order to up-grade the manufacturing process. Regarding the implementation of environmental management activities, the company functions autonomously.

Environmental management activities have been undertaken as a result of three major influencing factors:

1) direct economic savings associated with pollution control;
2) indirect benefits relating to public perception and competitive advantage and;
3) an increasing volume of legislation applicable to the environment.

6.2 Training

The company has a training plan which details a training schedule for each member of staff for each year. Training is ultimately the responsibility of the Director of Personnel and Administration although Heads of Department will provide input into identifying training needs. Training is provided primarily on -the-job or on-site. Training on the operation of new equipment is provided either by the suppliers or by external trainers. Generally, the foreman will receive external training and then he will be responsible for carrying out in-house training.

6.3 Environmental Training

Due to the nature of the industry, environmental training is provided for all new recruits. Half a day is spent on Health and Safety and Environmental issues. Each recruit is given a written training brief which outlines the environmental issues that are relevant to the operations of the company. However the company does not provide on-going environmental training.

7.0 OCCUPATIONAL ANALYSIS

This section presents an occupational analysis of four jobs: Smelter operative; Environmental Chemist; Technical Manger; and Human Resource Manager.

7.1. Smelter Operative

The Smelter Operative has responsibility for all operational aspects of the Smelter. None of his tasks relate directly to environmental management. The operative reports to the foreman. There have been a number of changes in the tasks carried out by the operative, mainly as a result of a shift from manually operated to micro-processor controlled equipment.

7.1.1 Tasks

The core tasks include:

- operating the furnaces - operation of valves, dampeners
- operation of refining plant
- driving mobile equipment
- cleaning/ sweeping

7.1.2 Skills and Competences

The skills and competences required in order to carry out these tasks are:

- numeracy/literacy
- ability to follow verbal and written instructions
- awareness of the Health and Safety issues, particularly the hazards associated with extraction
- an understanding of the operations
- an ability to recognise (and report upwards on) potentially hazardous incidents.

7.1.3 Training

There are no formal qualifications required for the post. The operative is trained primarily on-the-job although a certain amount of training is carried out on-site; eg, use of driving or lifting equipment. As a new recruit, the operative is provided with environmental training. However, the company does not provide on-going environmental training. There is a great deal of emphasis on training on Health and Safety.

7.2 Environmental Chemist

The Environmental Chemist is responsible for carrying out environmental monitoring and analysis on-site. The environmental chemist reports to the Process Engineer. All of the Environmental Chemist's time is allocated to environmental management tasks. The job content has changed firstly in the level of importance attached to the job. The company is more rigorous in its monitoring and recording activities. Secondly, the job has changed technically in terms of the type of equipment used, changes in the reporting systems and, because of COSHH, the company must monitor for new substances.

7.2.1 Tasks

The core environmental management tasks include:

- carrying out routine environmental monitoring programmes in accordance with targets, schedules and procedures: stack emission monitoring; exhaust ventilation checks; effluent quality control; workplace, personal and static air monitoring; external air and dust deposit gauges for lead and other environmentally significant particulates;
- reporting results to the Process Engineer;
- liaising with Production and Maintenance on corrective action as necessary
- ensuring the efficient operation of the liquid effluent plant
- ensuring the correct chemical dosing of the cooling water and exhaust gas scrubber systems and monitoring plant performance according to schedules and procedures

- ordering and maintaining adequate stocks of chemicals for the liquid effluent, cooling water and exhaust gas scrubber water treatment systems
- identifying faulty environmental monitoring/process control equipment and arranging repair or replacement
- assisting the Process Engineer in the development of environmental sampling and analysis techniques and effluent and cooling water process control regimes
- keeping environmental monitoring and process control records up-to-date
- undertaking various non-routine environmental or technical projects under the direction of the Process Engineer in order to respond to specific requirements.

7.2.2 Skills and Competences

The skills and competences required to undertake these tasks include:

- chemical background
- knowledge of metallurgical industries
- two years industrial experience
- knowledge of analytical chemistry
- limited knowledge of legislation

7.2.3 Training

The post-holder is required to have a GCSE in chemistry. Generally the post-holder would be brought in as an assistant environmental chemist and would effectively understudy the job for a period of time. Whilst a background knowledge of metallurgy is useful, specific knowledge of the lead industry can be acquired post-entry. Training is therefore provided primarily on-the-job although the post-holder might be sent on appropriate short courses. There are a limited number of analytical techniques carried out at the site and the post-holder will provide post-entry training in these.

7.3 Technical Manager

The Technical Manager reports to the Director of Operations. Approximately half of the post-holder's time is allocated to environmental matters. The emphasis attached to the environmental components of the job has increased. The Technical Manager has been responsible for producing an environmental plan, improving the standard of reports and ensuring that records are accurate. The tasks in the job have also changed as a result of the increased volume of legislation that is now applicable to the industry.

7.3.1 Tasks

The core environmental management tasks include

- keeping up-to-date with legislation
- ensuring the effective environmental control of the smelter is maintained to comply with all applicable legislation
- monitoring the effectiveness of the Laboratory in maintaining a quality service to Production and Commercial Departments
- supervising the Quality Management Function to ensure that necessary functions are achieved
- controlling all fuel and energy purchases and equipment useage to ensure that energy costs are minimised and appropriate equipment/systems are in place
- maintaining relevant procedures and practice to comply with Company standards in respect of Health and Safety using knowledge gained from legislation within the UK and EEC
- keeping abreast of the latest relevant technical developments by continuous review of appropriate technical literature and attendance at appropriate technical seminars and conferences
- negotiating with the regulatory bodies
- liaising with the public
- representing the company at various environmental meetings eg, the Lead Development Association Environmental Group
- deputising for the Director of Operations during his absence from the site.

7.3.2 Skills and Competences

The skills and competences required to carry out these tasks include:

- degree in chemistry, metallurgy or engineering
- a minimum ten years industrial experience
- knowledge of environmental control ie, legislation, technology and general issues
- broad understanding of metallurgical aspects of the process
- engineering knowledge
- understanding the environmental impacts of the processes
- organisational skills
- interpersonal, negotiating, and presentation skills
- report writing skills

7.3.3 Training

The Technical Manager is required to have a degree in chemistry, metallurgy or engineering and ten years industrial experience. The Technical Manager attends seminars and conferences on environmental issues and also attends Group courses. The Technical Manager's training requirements depend largely on legislative changes. Further informal training on legislation and technical problems has, in the past, been provided by the Regulatory bodies. The post-holder is not required to have formal training in environmental issues but rather has acquired environmental expertise through post-entry experience.

7.4 Human Resource Manager

The Human Resource Manager has overall responsbility for environmental issues within the UK Group. Environmental responsibilities have recently been incorporated into this post although it is expected that in the future a new post may be created. Currently only 5% of the post–holder's time is allocated to environmental affairs. This is expected to increase to 20%.

7.4.1 Tasks

The core environmental tasks include:

- devising an environmental strategy
- carrying out a co-ordinating role between the companies
- providing management information
- liaising with technical management regarding process change

7.4.2 Skills and Competences

The skills and competences required to carry out these tasks include:

- experience of strategic planning
- ten years working experience
- knowledge of legislation
- ability to understand the underlying issues and therefore anticipate the direction in which legislation will move
- broad understanding of the metallurgical processes
- broad grounding in environmental issues
- understanding of the environmental impacts of the manufacturing processes

7.4.3 Training

The current post-holder has a background in personnel and ten years personnel management experience across a broad range of functions. In the future a separate post is likely to be created which would be suitable for either a traditional scientist or an environmental scientist.

8.0 FUTURE

The company is increasingly allocating more resources to R&D into clean technologies. In this context it is difficult to anticipate skill and training requirements for the future as industry may undergo radical changes in processes and technologies. In terms of the requirement for specialists in environmental

science there is not perceived to be a need in the foreseeable future. However in the long term, changes in both legislation and technologies may change industry's requirements. Regarding training provision the company aims to recruit a higher quality of staff in order to minimise the requirement for training.

9.0 SUMMARY AND CONCLUSIONS

Case Study M5 presents a medium-sized secondary lead smelting company which produces lead ingots. The company's operations are governed by the Control of Lead at Work Act 1980. The company is thus subject to HMIP control.

The company has produced an environmental plan which details short term emisssions' targets and medium term environmental objectives. The company must also adhere to the Group environmental policy which sets out the overall environmental strategy. Whilst the company operates independently, it benefits from having access to Group resources. The company has installed state-of-the-art pollution control equipment and within the industry is recognised as being pro-active in environmental managemnent. The company aims to stay ahead of environmental legislation whilst maintaining a competitive edge. There is concern that a company which complies fully with legislation may lose competitiveness against a company which is operating in a region or country where legislation is not rigorously enforced. The company is currently undertaking R&D into new, clean technologies in anticipation of regulations. To date, the company has benefited from the advisory role played by the regulatory bodies and is concerned that this valuable source of information and advice may diminish in the future.

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